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THE REACTION OF THE INTRAOCULAR PRESSURE TO OSMOTIC VARIATION IN THE BLOOD*

BY

W. S. DUKE-ELDER, M.A., B.Sc., M.D., F.R.C.S.

PLIMMER RESEARCH FELLOW IN PATHOLOGY

I. Introduction

With the exception of the comparatively unimportant factor of the influence of external pressure acting directly on the globe of the eye (orbital musculature, etc.; Parsons[67], 1904), the great mass of experimental physiological investigation on the intraocular pressure has taken the form of its correlation with the blood pressure. It has been amply demonstrated (Henderson and Starling[39], 1904), that, under experimental conditions, that is, for sudden and marked changes, the intraocular pressure varies directly and very intimately with the arterial blood pressure, and authority has always stated (Leber[54], 1873; E. T. Collins[15], 1925) that proof of a controlling mechanism, other than vaso-motor, is wanting. Allowing for the fact that conditions in the ocular circulation may be widely different from those obtaining in the general systemic circulation, it would appear that the pressure in the eye may vary clinically quite independently of that in the retinal artery (Duverger and Barré[20], 1920; Velter[93], 1920; Bleidung[10], 1924, etc.). Allowing further for the consideration

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that, if the intraocular pressure varies with any element of the blood pressure, it will be with the capillary pressure—a totally different variant from arterial pressure; that, counteracting especially slow and prolonged changes, the conditions of elimination of fluid from the normal eye constitute, within limits, a very efficient mechanism to retain normality; and that, with the methods at our disposal clinically, we can obtain accurate measurements neither of the pressure of the blood nor of the intraocular fluids; nevertheless the concensus of opinion of students of the subject from the clinical aspect in every country would seem to lean to the conclusion that the two do not vary in parallel, and that, while there is an association between them, that association would seem to be accidental rather than essential. Between the physiologist and the clinician a certain divorce of opinion has thus arisen; but as all clinical phenomena must ultimately be explicable on a physiological basis, the fact that experiment is not in accord with clinical experience merely shows that other factors must be taken into account. It is probable that these concern the more subtle considerations of physical chemistry biologically applied. Neglecting for the moment the partial impermeability of the lining cells of the eye, it is generally conceded that the energy necessary for the maintenance of the intraocular pressure is derived from the blood-stream; but, in considering this, in addition to the external dynamic energy of the blood in mass movement, which is measured as blood pressure, we must also take into account the internal kinetic energy of the blood in molecular movement, which is measured as osmotic pressure.

The considerable disturbance which osmotic derangement can cause in the ocular mechanism has already been discussed in the case of diabetes (Duke-Elder[19], 1925), but this aspect of the subject has attracted a comparatively small amount of investigation. Troncoso[91] (1901), by the intravenous injection of large quantities of normal saline produced a large but transitory rise in the intraocular pressure—a rise which one would presume to correspond with a parallel rise in blood pressure. Since, however, he did not measure the latter, his results are of little value.

By the injection of hypotonic solutions, Ruben[74] (1914) and Weekers[96] (1924), produced a definite rise in intraocular pressure. Conversely, by the injection of hypertonic salt, Cantonnet[11] (1904) demonstrated a shrinkage in the volume of the eye; Scalinci[76] (1907) called attention to changes in the physico-chemical properties of the ocular fluids; Angelucci[1] (1913) using Leber's filtration manometer, concluded that the filtration rate of the aqueous was diminished, and Tristaino[90] (1912), using concentrated solutions of calcium chloride, produced definite and graduated decrements

in the tension of the eye. Starting from the consideration of diabetic coma, Hertel[41] (1913) evolved a theory on an osmotic basis to account for the clinical occurrence of the soft eye met with in this condition, and later (1914)[43] he published a series of experiments wherein, working on rabbits, by the intravenous injection of anisotonic solutions of widely different substances in differing concentrations, he succeeded in producing definite variations in the ocular tension. In these experiments, however, he was content to use a Schiötz tonometer to register intraocular pressure at long intervals, and parallel records of the blood pressure were not taken; their physiological value is therefore small.

Considerably later, Magitot[60] (1923), experimenting on cats and dogs, failed to obtain any definite variation in intraocular pressure apart from the blood pressure by anisotonic injections. On increasing the strength of injection a large number of his animals died; his paper, however, makes no mention of the amount of salt used nor of the relative rate at which it was introduced. In the rabbit he obtained results comparable to those of Hertel, of which, however, he was unable to take graphic records. This discrepancy in results with different animals led him to consider Hertel's osmotic explanation improbable, and he regarded the response of the rabbit as exceptional, and, in accordance with his well-known views, dependent upon a vaso-motor effect governing the calibre of the vessels of the choroidal tunic.

In view, however, of the difficulty in accounting for the inactivity of a known and very definite physical force; in view of the great variety of the substances used by Hertel for injection (sodium chloride, sulphate, phosphate, carbonate, acetate, butyrate, isovalerianate, sugar, urea, etc.), and of the fact that their action varied, not with their chemical nature, but with their relative osmotic potential activity; in view of the fact that a similar variation has been shown by Weed[95] and his co-workers (1919) to occur in the cerebro-spinal fluid of cats and dogs; and in view of the fact that a corresponding tension variation can be induced clinically in the human eye, it would seem unlikely that the phenomenon was a peculiarity depending on the vaso-motor mechanism of the eye of the rabbit. Apart from the importance of the theoretical considerations involved and considering the clinical value of the lowering of ocular tension which can undoubtedly be obtained thus in cases of glaucoma, it would seem important that further investigation be undertaken into the question.

II. Experimental Technique

The animals used throughout the investigation were cats. Anaesthesia was induced by open ether followed by the intravenous injection of a solution of chloralose (0.075 gms. per kilo

body wt. in 10 c.c. Ringer's solution). This was found to be a most satisfactory anaesthetic, and gave a uniform and perfect narcosis. It ensured the absolute immobility necessary for the undisturbed maintenance of a manometer in the eye, and under its influence the animals, with little or no attention, kept alive and in good condition without fluctuations in the blood pressure, heart and respiratory rate, and intraocular pressure (as seen in controls) over periods of observation lasting several hours. For most physiological work on pressure variations in the eye curare is indispensable to eliminate the action of the extraocular musculature. In this series of experiments, inasmuch as the change is a slow and gradual one, it was considered that this factor could be neglected. During anaesthesia the animals' body-heat was maintained by electric bulbs placed underneath the cat-table.

The intraocular pressure was recorded by a compensatory manometer of 1 mm. bore of the type introduced by von Schultén[77] (1884) and modified by Parsons[67] (1903) and Henderson and Starling[39] (1904), the compensatory mechanism being a reservoir controlled by a pulley. Saline was used as giving more accurate readings than mercury with its large inertia and its small range of variation. The constancy of the intraocular contents was assured by the introduction of a horizontal, graduated tube of capillary bore between the manometer and the eye, into which a bubble of air was admitted, any movement of which towards or away from the eye indicates entrance or exit of fluid, which must be counteracted by altering the pressure in the system by adjustment of the reservoir. The needle employed was a sharp hollow instrument, as devised by Starling, with three openings—one terminally and two laterally—to ensure free communication with the fluids of the eye, and connection by a lateral arm with the manometer left its distal end closed by a plug which could be replaced by a stylet for cleaning out any obstruction. The needle was introduced into the anterior chamber through the cornea near the limbus, parallel to the plane of the iris. On the insertion of the needle there is always some pressure reaction, but provided it is sharp enough, and pushed evenly and rapidly into the anterior chamber, this is found to be transitory. Less pressure and consequent disturbance are involved if the cornea is first partially penetrated with the point of a very sharp knife. The temporary nature of the initial disturbance was verified by the insertion of a second needle of similar bore in an experiment, and the observation of its effect on the pressure as registered by the manometer attached to the first (*cf.* Hill[44], 1913), always provided that in its introduction the iris be not injured, a complication which causes a considerable rise of tension (*cf.* Magitot[61], 1922; Weekers[90], 1922). Complete equilibrium was always obtained within 15 mins. and until such

equilibrium had been attained for a control period of at least 10 mins. no experimental procedures were commenced. During the experiments, if an excursion of the air-bubble in the capillary tube of at least two degrees did not coincide with the arterial and respiratory rhythm, thus demonstrating free communication with the intraocular fluids, the experiment was discontinued. Immediately on the insertion of the needle it was carefully supported, since any traction by its weight on the cornea increases the tension of the eye and vitiates pressure records. Readings were taken continuously during the initial period of rapid variation; later, when slow pressure changes were taking place, they were recorded every three to five minutes.

The arterial pressure was recorded by the usual mercurial manometer recording on a kymographic drum, the cannula being inserted into the femoral or external iliac artery, this being the most convenient vessel of sufficient size leaving the entire circulation of the head in a normal condition. At the stage in the experiments when rapid variations occurred a continuous tracing was taken; thereafter readings were taken at 5 to 10 min. intervals to obviate difficulties due to clotting.

The venous systemic pressure was recorded by a cannula inserted proximally into the femoral vein of the side opposite to that used for arterial records, close to the crucial anastomosis, so as to obtain virtually a lateral pressure. This was connected to a vertical glass tube of 1 mm. bore into which was introduced a small quantity of physiological citrate solution. The pressure was taken by reading the resultant level in the manometer tube directly as mm. of saline. The very small amount of fluid thus entering the circulation has no appreciable effect on the general pressures (*cf.* Weed and Hughson[95], 1921). It is held by some (Becht[8], 1920) that the systemic venous pressure is a consideration of no value, but although its level at different situations is profoundly modified by local conditions, yet, to a large extent these different values vary correspondingly, and the results obtained, although in no way claiming great accuracy, would yet appear to be of some interest.

The urinary excretion was estimated by introducing a cannula into the apex of the bladder, obliterating the volume of the latter as much as possible, and counting the drops per minute flowing from it, the urethra being ligated. Here again no claim is made to great accuracy, but a sufficient degree is obtained to indicate the periods of diuresis.

In this series of experiments no attempt was made to measure directly the osmotic variation of the blood. In the absence of a more rapid or trustworthy method, recourse was had to the determination of the lowering of the freezing point, and a correla-

tion of the results so obtained with a study of the changes occurring simultaneously in volume. It is not contended that by cryoscopy, or by a determination of any of the colligative properties of a fluid so far removed from the "perfect" solutions of van't Hoff as is blood, an exact estimation of the osmotic pressure can be made, but it is held that results can be readily obtained thus of sufficient approximation to be of value. The freezing point was estimated with the usual Beckmann apparatus, centrifugalized serum being used as being more easily manipulated; this introduces no error, since the presence of corpuscles, like other suspended particles, leaves the osmotic pressure unchanged, the plasma and corpuscles being two phases of a system in equilibrium (Hamburger[34], 1897). The blood volume was estimated, also indirectly, by a red-cell count (by the Thoma-Zeiss haemocytometer) correlated with a haemoglobin estimation (by Haldane's method). Since the total number of red cells does not change under the conditions of the experiments (haemolysis was never observed), and since the volume is altered by a fluid lacking in haemoglobin, while these values remain constant absolutely, they will change relatively to the volume, varying inversely to it.*

The solutions used for injection were given intravenously through a cannula fixed proximally into the saphenous vein, fed from a burette. By this method of administration the amount was readily measured, and the rate at which it was introduced was accurately and uniformly controlled at a time in the experiment when attention was urgently required for the observation of rapid pressure changes. This question of rate of administration was found to be very important.

The results obtained in typical experiments are represented below. A considerable amount of variation was encountered in the reaction of different animals, both as regards the degree of change, the time of incidence, and the duration, but in every case the general change showed the same constant tendency.

III. Controls

(*a*) In order to test the efficiency and constancy of the anaesthetic, the maintenance of body temperature and general condition, and the adequacy of experimental conditions throughout the periods necessitated by the nature of the observations, controls were conducted over similar intervals of time, wherein the animals were subjected to no further manipulation than the operative procedures required for the adjustment of the various recording apparatus. The example recorded (Fig. 1) shows the degree of

* The principle of this method assumes the even distribution of the red cells throughout the entire circulation, an assumption not universally granted: See Lamson [53] (1915), Krogh [52] (1920); contrast, however, Scott [78] (1917).

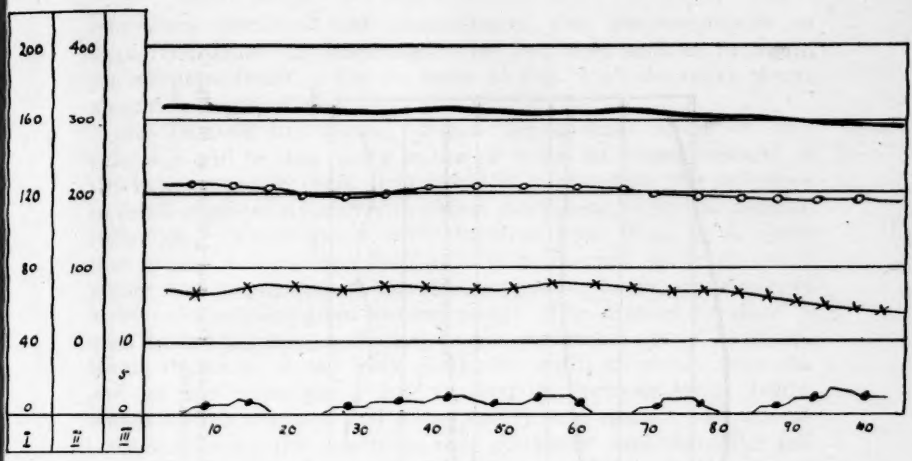

FIG. 1.

Control exper. Cat: female: 2,800 gms.: chloralose. The ordinates represent pressures: column I, arterial pressure in mm. Hg. (graphed in circled line) and venous pressure in mm. saline on same scale (graphed in crossed line); Column II, intraocular pressure in mm. saline (graphed in heavy line); Column III, urine in drops per min. (graphed in dotted line). The abscissae represent time in mins.

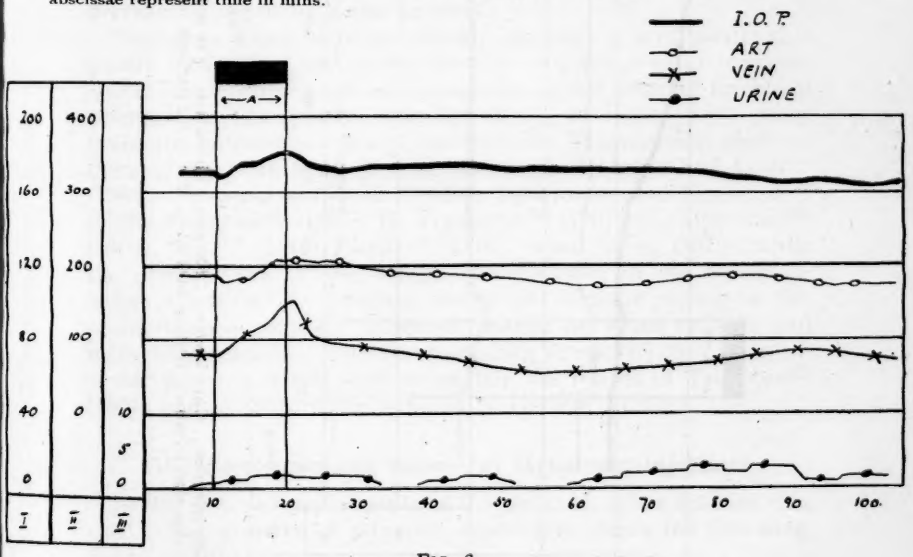

FIG. 2.

Control exper. Injection of normal saline. Cat: female: 3,200 gms.: chloralose. The ordinates represent pressures as in Fig. 1; the abscissae time in mins. During interval A 30 c.c., 0.9 per cent. saline injected intravenously.

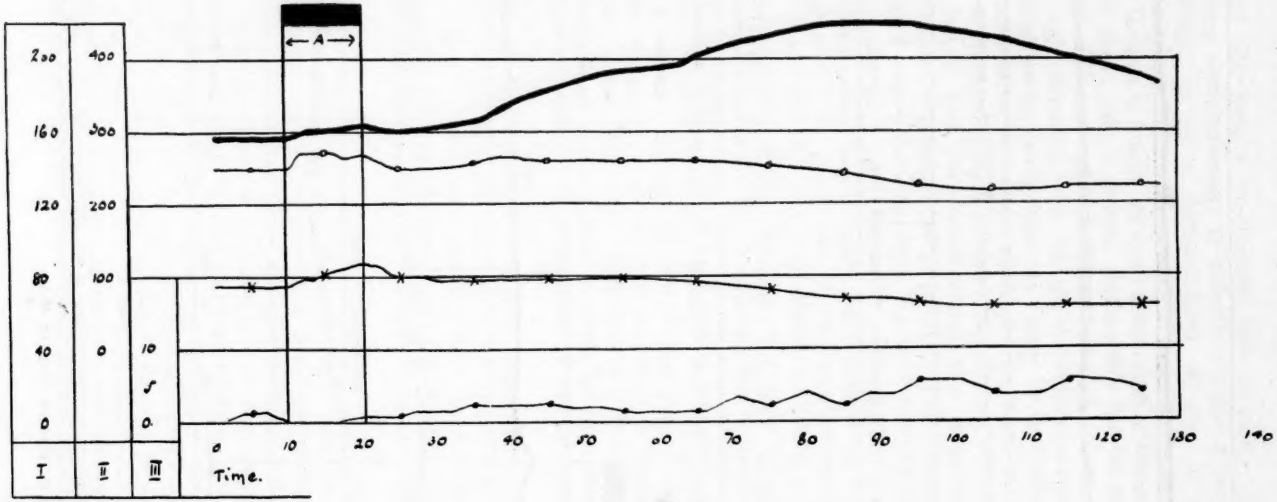

FIG. 3.

Hypotonic injection. Cat: female: 2,800 gms.: chloralose. The ordinates represent pressures, read and graphed as in Fig. 1; the abscissae time in mins. During interval A, 25 c.c., 0.3 per cent. saline injected intravenously.

constancy obtained, and demonstrates that the conditions of experimentation had eliminated error and were such as to obtain an adequate result. On the basis of Fig. 1 all the other charts should be interpreted.

(*b*) Isotonic Injections. Since the general effect of any injection will be due partly to the effect on the blood pressure of the injection mass itself, it is essential to eliminate this influence in order to assess accurately the effect due to any additional osmotic influence. Experiments were therefore done (Fig. 2) to show this purely volumetric effect, in which isotonic (0.9 per cent.) saline was introduced in amounts equivalent to the quantities of anisotonic solution used subsequently. The arterial pressure is seen to fall slightly, and then to rise somewhat above its initial level; thereafter it fell very gradually until, 20 mins. after the end of the injection, it had reached its previous level, below which it sank slightly, and subsequently rose again. The venous pressure during the injections rose markedly, and thereafter fell as quickly, remaining slightly below its initial level for almost an hour. The urine excretion was not greatly affected; if anything it was increased. The intraocular pressure showed a close and intimate connection with the blood pressure throughout; a slight initial fall followed by a rise during the injection, thereafter a decrease followed by a rise in level.

The effect therefore of an isotonic injection is very small; it is purely mechanical and varies directly with the amount injected; and the intraocular pressure follows closely the curve of the blood pressure. The general vascular effect—an initial rise, soon becoming subnormal—is well recognized. Experimental observations amply confirming this include those of Dastre and Loye[17] (1888), Cohnstein and Zuntz[14] (1888), Johannsson and Tigerstedt[49] (1889), Grosglik[29] (1890), R. Tigerstedt[89] (1907), C. Tigerstedt[88] (1908), Selig[79] (1910), Bayliss[5] (1916), Weed[95], etc. (1919), while the phenomenon is well recognized clinically in the failure of saline injections to maintain the blood pressure owing to the rapid compensation for increased volume by tissue oedema and increased excretion. The corresponding temporary rise of intraocular pressure would seem to explain the results of Troncoso[91] (1901) and to confirm the findings of Hertel[43] (1914).

IV. Anisotonic Injections—(a) Hypotonic Injections

In this series of experiments an 0.3 per cent. saline solution was used. The protocol of a typical experiment shows the following variation (Fig. 3).

The arterial pressure during the injection rose initially, fell slightly, and finally rose again through 8 mm. Hg. Five mins.

after injection it had fallen to its original height, slowly to rise again to a maximum of +6 mm. Hg. in 20 mins., after which it fell gradually. The venous pressure showed a comparatively small rise of 15 mm. saline during the injection, fell gradually, reaching its initial level in about 50 mins., and continued slowly to decrease. The intraocular pressure during the injection rose with the blood pressure, and immediately afterwards showed a tendency to decrease with it, which, however, was soon replaced by a rise which became much steeper 15 mins. after the injection, and attained a maximum of 450 mm. of saline in 75 mins., whereafter it began to fall. The urine, which remained normal at first, increased largely at about 75 mins. after the injection, the increase in diuresis in the second hour corresponding roughly with the fall in arterial and venous pressures below their initial level, and with the commencement of decline in the intraocular pressure. Before the experiment started the depression of the freezing point of the serum (Δ) was $-0.628°C.$; 15 mins. after the injection it had decreased to $-0.613°C.$; 60 mins. after it had begun to return to normal, standing at $-0.618°C.$ No appreciable volume change could be made out.

The intraocular pressure therefore shows a variation initially parallel to both the arterial and venous curves, being of the same direction and magnitude as these; later, however, it becomes completely divorced from them, showing a marked and sustained rise over a considerable period of time.

(b) Hypertonic Injections

(1) *Hypertonic Saline.* In this series of experiments a 30 per cent. solution of sodium chloride was used; a typical variation is as follows (Fig. 4):

Immediately on injection the arterial pressure fell suddenly and rapidly from 115 to 75 mm. Hg. during the first two minutes, and then commenced to rise slowly. By the end of the injection it had risen to 90 mm.; 10 mins. afterwards it had reached its initial value; 30 mins. afterwards it had exceeded this, reaching a maximum of 130 mm.; thereafter it slowly fell to the region of its initial level. The venous pressure rose rapidly during the injection until it had almost doubled its original value (83 to 150 mm. saline). Immediately after the injection was completed it fell as rapidly during the first 5 mins., and thereafter more slowly, until, half an hour later, it had reached its normal level, after which it tended slightly to rise again. The intraocular pressure during the injection fell at first rapidly and profoundly (345 mm. saline to 180); thereupon it rose as rapidly until at the end of the injection it had exceeded its initial value and had reached a peak of 415 mm.

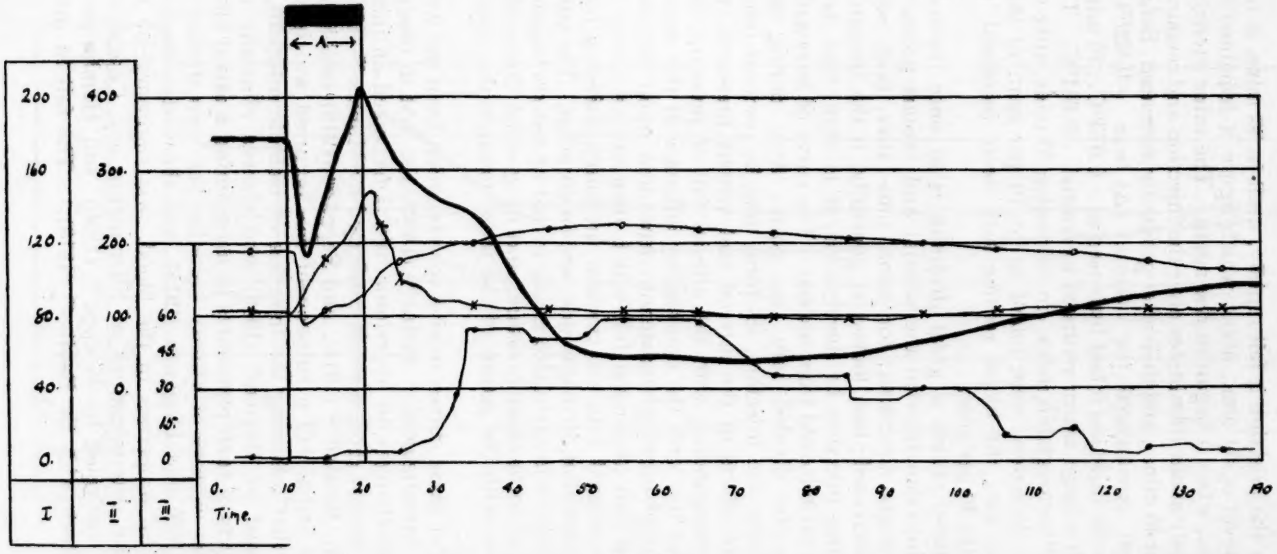

FIG. 4.

Hypertonic injection. Cat: female: 3,600 gms.: chloralose. The ordinates represent pressures read and graphed as in Fig. 1; the abscissae, time in mins. During interval A, 15 c.c., 30 per cent. saline injected intravenously.

saline. After the injection it fell rapidly, until in 30 mins. it had attained the level of 50 mm., about which figure it remained for about 40 mins., when it began to rise again. The urine excretion rose enormously about 10 minutes after the injection and remained high for about 45 mins., and thereafter gradually decreased. Before the experiment commenced the value of (Δ) was $-0.629°C.$; 20 mins. after the injection it had increased to $-0.673°C.$; 75 mins. later it had to a large extent returned to normal $-0.641°C.$ The red count and haemoglobin index, on estimation 30 mins. after the completion of injection, were found to be 70 per cent. of their normal value, *i.e.*, the blood volume had been increased by (approximately) 30 per cent.

Between these curves a great diversity is at once evident. During the injection interval the arterial and venous pressures varied in opposite directions; for some time after, both were temporarily increased; but, looked at generally, if the transitory changes during injection be disregarded, it is seen that both remained not far removed from normal. The curve of intraocular pressure may be divided into two parts; first, during and immediately after the injection, its form may be resolved into a composition of effects of the arterial and venous pressures, the initial fall corresponding with the arterial fall of pressure, and the subsequent rise with the dominating influence of the venous pressure—a mechanical phenomenon dependent upon volume. The profound and prolonged fall which then occurs cannot in anyway be correlated with the vascular pressures, differing from them both in direction, in magnitude, and in duration. The curve of urinary excretion is again interesting in that its rise corresponds with the fall of intraocular pressure, and its gradual diminution is synchronous with the return of the latter towards the normal level.

The forms of these curves receive corroboration from the work of previous investigators. Heinz[38] (1890), the first to observe blood pressure changes on hypertonic injections, noted an initial fall until the animal died, a result confirmed by Münzer[66] (1898). Selig[79] (1910), Retzlaff[71] (1915), and Seppä[80] (1918) established that after the initial fall a subsequent rise occurred which was greater than that following the injection of isotonic solutions, a result confirmed by Bayliss[6] (1919) who showed clinically the transitory effects of such procedures in maintaining a raised blood pressure. The increase of urinary excretion has been studied by Starling[85] (1899) and Hogan[45] (1915), and the early return to normal physical properties in the blood, first suggested by the specific gravity determinations of Sherrington and Copeman[81] (1893), was confirmed by Koeppe[50] (1896) and Hamburger[34] (1902), and dealt with by Bayliss[4] (1919). The fall in intra-

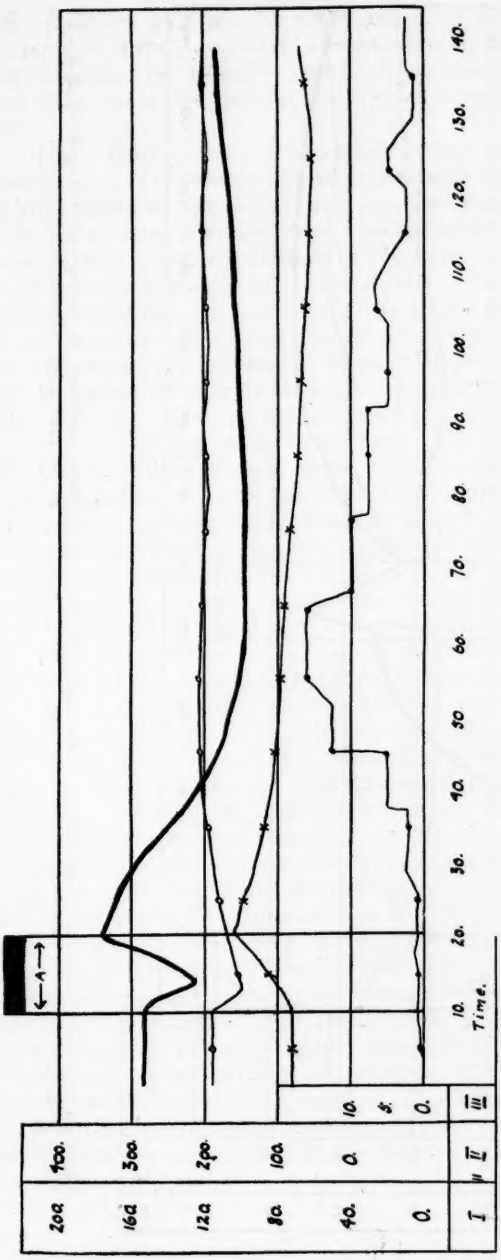

FIG. 5.

Hypertonic injection: glucose. Cat: female: 3,500 gms. Ordinates represent pressures read and graphed as in Fig. 1; abscissae represent time in mins. During interval A, 30 c.c. 50 per cent. glucose injected intravenously.

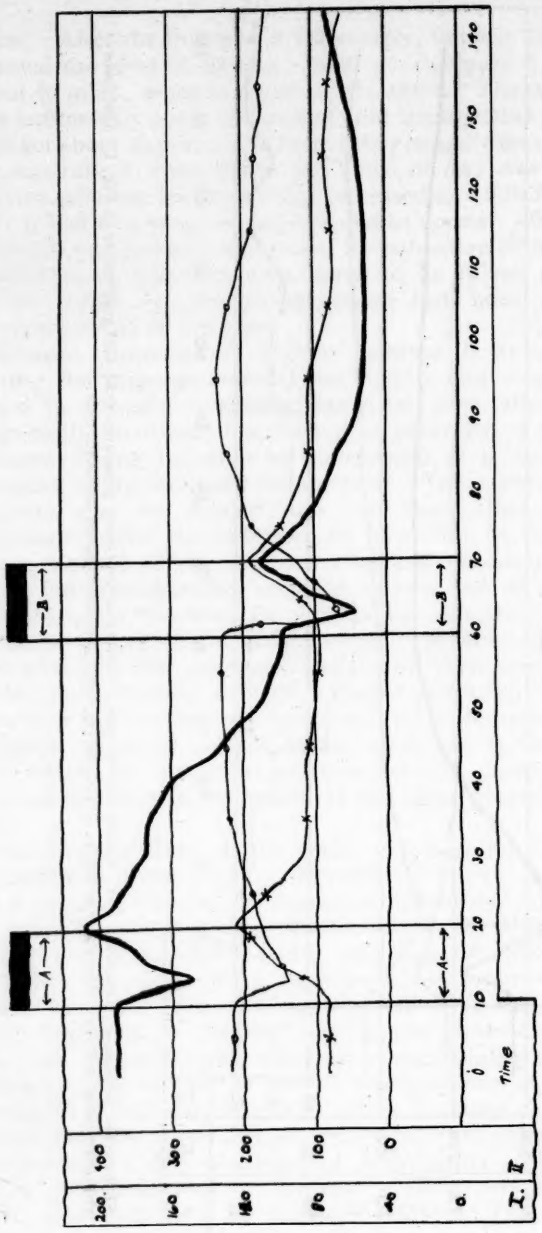

FIG. 6.

Repeated hypertonic injection. Cat: female: 3,400 gms.: chloralose. Ordinates represent pressures read and graphed as in Fig. 1; abscissae represent time in mins. During intervals A and B, 12 c.c., 30 per cent. saline injected intravenously.

ocular pressure confirms the observations of Tristaino[90] (1912) and Hertel[43] (1914), and bears a considerable resemblance to the results obtained by Weed[95] and his co-workers on the cerebrospinal fluid, on whose technique these experiments were largely based.

(2) *Hypertonic Sugar.* If the effects noted are due to osmotic considerations, it is evident that similar results should be obtained with any substance capable of varying the osmotic pressure. A similar experiment was therefore conducted with a solution of glucose, and it showed a change of the same character (Fig. 5). Here, however, as was to be expected, the variations were not so great in magnitude, since, owing to its larger molecule and lack of ionization, the osmotic activity of a solution of sugar is very much inferior to one of salt. Thus a 30 per cent. solution of sugar is osmotically equivalent to a 4.5 per cent. solution of sodium chloride. The clinical analogue of this experiment is the occurrence of soft eye in diabetic coma.

(3) *Effect of repeated injections.* Experiments were done to determine whether the eye was refractory to repeated injections, one of which is graphically represented (Fig. 6). It is seen that a subsequent injection has an effect similar to the first, intensifying its action and prolonging the effect. In no case was it found possible to reduce the tension to *nil*, or to a negative value; before such a result was attained, the animal invariably died.

(4) *Rate of injection.* One of the most striking features in the reaction of the animal to hypertonic injections is the sudden and rapid fall of blood pressure initially, and in any clinical application of this method of reducing the tension of the eye, this factor is of great importance and necessitates considerable caution. This preliminary fall denotes a profound systemic disturbance, and it is of importance that the osmotic storm, so created by the introduction into the blood stream of a large amount of crystalloid, should be made as mild as possible. An investigation was therefore conducted into the effect of the rate of injection, typical findings of which are shown in Fig. 7. In this experiment 5 c.c. of 30 per cent. saline were given at varying rates of 20 mins., 10 mins., and 2.5 mins. The first showed a mild effect on the arterial pressure, corresponding to that obtained on the exhibition of glucose; the second showed a marked effect; and in the third the blood pressure fell very rapidly from 124 to 44 mm. of Hg., and then, after a few oscillations, dropped to 0. Meantime the animal showed a quick pulse, rapid shallow breathing, went into mild convulsions and died of cardiac and respiratory failure. The degree of disturbance entailed by the injection therefore varies as the rate of administration.

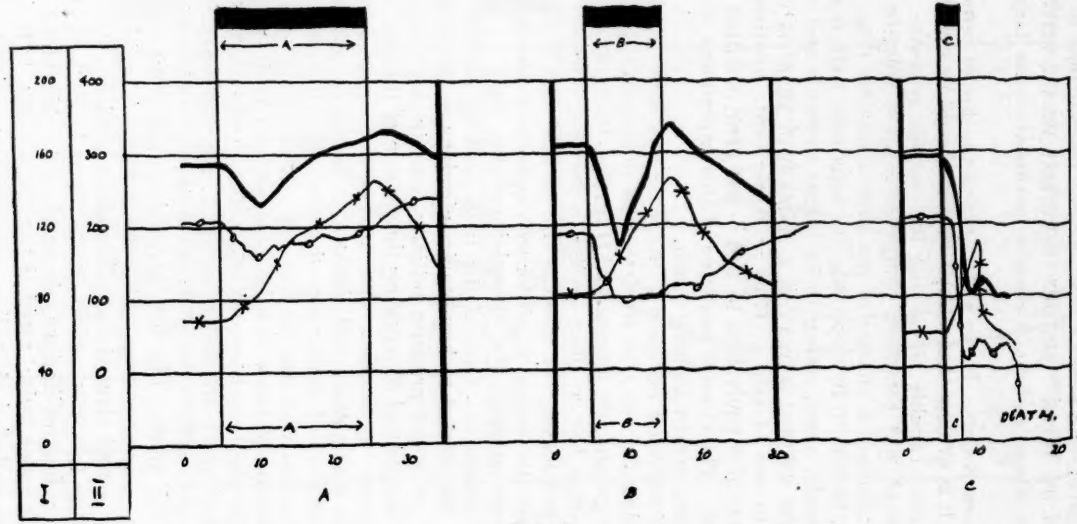

FIG. 7.

Hypertonic injections : effect of rate.
A. Cat : female : 3,700 gms. : chloralose. During interval A, 5 c.c. 30 per cent. saline intravenously.
B. Cat : female : 3,300 gms. : chloralose. During interval B, 5 c.c. 30 per cent. saline intravenously.
C. Cat : female : 2,780 gms. : chloralose. During interval C, 5 c.c. 30 per cent. saline intravenously.
Ordinates represent pressures read and graphed as in Fig. 1 ; abscissae time in mins.

Were the injection made slowly enough, even in large quantity, the processes of metabolism and excretion would be sufficient to deal with and dispose of the excess material without allowing any great alteration in osmotic equilibrium. Thus in a research to estimate the sugar-using power of men and animals by giving prolonged, uniform injections of glucose intravenously, Woodyatt, Sansum, and Wilder[101] (1915) found that in man, in the rabbit, and in the dog, 0.9 gms. of glucose per kilo. wt. (*i.e.*, 63 gms. in a man of 70 kilos.), could thus be given per hour over long periods of time without producing any pathological phenomena; above this rate glycosuria and diuresis occurred. To effect a raising of osmotic pressure a mean must be struck between these two, whereby a sufficiently large water-traffic is set up to obtain the desired result. It is obvious, therefore, that we must take as our standard of dosage, not a weight of salt, but a relative velocity-weight, *i.e.*, a weight of salt per unit of body weight, introduced per unit of time.

On these considerations depends the lethal dose of hypertonic salt, which has been very variously estimated by different investigators. Thus Guttmann[31] (1865) in rabbits, found it to be 5 gms. NaCl given as a 20 per cent. solution, Silbermann[84] (1889) states that 4 to 12 gms. kills rabbits, Heinz[38] (1890) puts it at 20 c.c. of a "concentrated" solution, Münzer[66] (1898), at 3.72 gms. per kilo. body wt., and Seppä[80] (1918) at 1.95 gms. per kilo. of animal injected at the rate of 1 c.c. of a 26.4 per cent. solution per minute. In the experiment quoted (Fig. 7) 0.8 gms. per kilo. wt. proved fatal when injected at the rate of 2 c.c. of a 30 per cent. solution per minute, and other observations showed that anything over 1.5 gms. per kilo. wt. of the same solution could not be given at the rate of 1 c.c. per minute with impunity. In the above series of experiments the average velocity-weight of salt dosage was 1.2 gms. per kilo. wt., introduced approximately at 1 c.c. per minute, thus keeping well within the lethal dose. It is evident that in any clinical application a large margin of safety should be left.

(5) *Alimentary Administration.* The same osmotic effect ought theoretically to be obtained by the administration of hypertonic solutions by any route. Experiments were therefore conducted wherein a large quantity, 150 c.c. of 30 per cent. salt solution, was introduced into the stomach of cats by a stomach tube. A typical record is figured in Chart 8. As would be expected from the slow rate of absorption, the initial sudden changes are absent; the small oscillations on the curves corresponded to vomiting movements which were difficult to eliminate, and are therefore vaso-motor effects. Apart from these incidental variations the blood pressures kept fairly level,

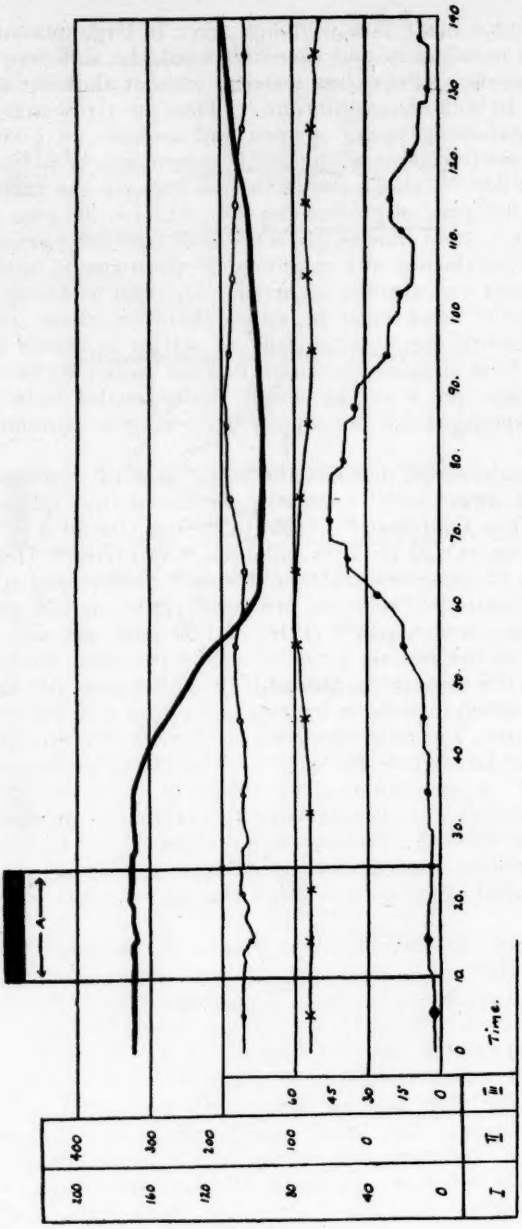

FIG. 8.

Hypertonic saline by alimentary route. Cat: female: 2,900 gms.: chloralose. Ordinates represent pressures, read and graphed as in Fig. 1; abscissae time in mins. During interval A, 130 c.c. 30 per cent. saline introduced into stomach.

showing a slight rise in both, followed by a slight fall more marked in the venous pressure than in the arterial. At first, through the initial oscillations, the curve of intraocular pressure follows closely those of the blood pressures; later it departs completely from them, falling as in the case of the intravenous injection, but to a less degree.

V. Mechanism of Action

That the reaction studied in this investigation is controlled by osmotic influences is suggested by three considerations; the nature of the change, the variety of substances causing it, and the generality of its application to different parts of the body.

A study of the nature of the pressure curves, and a comparison of the varying effect of the injection of different strengths of solution at different rates by different routes, demonstrate clearly that there are two distinct influences at work, involving two distinct responses; the first, a rapid, immediate change, following closely and depending upon the variation in part of the arterial, in larger part of the venous pressure, and therefore presumably entirely, of the (immeasurable) capillary pressure; the second, a later, more gradual, less variable change, completely independent of any blood pressure variation, differing from it in time of incidence, in rate of development, and usually in direction.

The first can be correlated with a corresponding change in the capillaries in a very striking manner. If the inner aspect of the ear of a cat with non-pigmented skin be cleaned and shaved and flooded with oil, and examined through the microscope with the aid of direct illumination derived from a brilliant light focussed by a condensing lens, a beautiful picture of the cutaneous capillary circulation can be obtained (*cf.* Lombard[58], 1912). On a muddy yellow background, showing up somewhat hazily, the papillae of the superficial skin vessels are seen grouped mainly round the hair-follicles as little red mounds, from which spring upwards tiny twisted capillary loops remarkably clearly defined, and between which is spread a fine network, visible clearly when the vessels nearly approach the surface, always being broken as the vessels fade away more deeply into the layers of the corium. The capillary walls themselves are not visible, but the column of blood can be readily observed, and the behaviour of the capillary bed, and its reaction to stimuli, can be studied. With the aid of a micro-scale a very exact record of degrees of change can be made. Under these conditions the average diameter of a capillary in the cat's ear is from 8 to 10 μ; the diameter of the cat's red cell is 6 μ; and under various stimuli, variations in the former ranging from 4—5 μ to 12—13 μ are easily induced. In

this manner the probable conditions in the capillaries of the eye may be deduced when anomalies seem to be met with when the general blood pressure alone is measured: thus, for example, the rise of intraocular pressure coincident with the fall of blood pressure on the exhibition of amyl nitrite can be observed, by analogy, to be due to capillary dilatation. Similarly, on the injection of hypertonic salt, the capillaries of the ear are seen to constrict somewhat, and then to dilate, the dilatation gradually and very slowly subsiding, their behaviour being much as one would expect from the venous pressure and the change in blood volume, and following very closely the initial changes observed coincidently in intraocular pressure. If the ear of a rabbit be enclosed in a plethysmograph, a similar volume change, as Haupt[37] (1915) observed, can be registered. At the end of forty-five minutes, when the intraocular pressure has fallen largely, the capillaries are still dilated: the effect seems to pass off gradually and slowly, as if it were governed solely by volumetric conditions, and there would seem to be no evidence of any inherent contractile activity of the endothelial wall induced by the altered chemical constitution of the blood.

The second response can only be correlated with the physico-chemical changes occurring in the blood-stream after its flooding with dialysable substances. It is extremely unlikely that such a change could be determined by a vaso-motor influence governing the choroidal vessels as Magitot suggests. Such a change could be brought about only by either a passive dilatation or constriction of the vessels depending on volume, or by an active change determined locally by the activity of a vaso-motor nervous mechanism. The first, as we have seen, is negatived by the fact that, after a hypertonic injection, when the intraocular pressure is falling, the blood volume is increasing by 30 per cent. owing to dilution by tissue fluid, corresponding to the simultaneous rise in both arterial and venous pressures. Any passive effect on the circulation will therefore be in the sense opposite to that found in actual fact. Since a nerve impulse is determined by the passage of ions through semi-permeable membranes, it is, by its nature, susceptible to osmotic changes. That a nervous mechanism, however, cannot be the governing factor in the changes observed is evident from recent work on the effect of osmosis on nerve activity. The literature of this subject, from the time of the first observations by Eckhardt[23] (1851) and Kölliker[51] (1856) down to those of Renauld[70] (1910) and Ishikawa[48] (1912), shows much contradictory evidence. The discrepancies among these early observations arose in the adoption of the strength of a minimal (threshold) stimulus required to give a contraction response as a standard of measurement. Tanamura[87] (1916), however, showed

that, in measuring osmotic pressure variations, the electrical resistance of a nerve varied with the tonicity of the immersing solution, and that such a variation of resistance caused a deviation of threshold value; thus he deduced that the threshold strength as an index of excitability implies an error due to variation of electrical resistance. Verworn[94] (1914) had previously pointed out that excitability and propagation velocity were two factors of the same physico-chemical reaction, varying parallel to each other under changing conditions. Taking advantage of the fact that the latter can be measured exactly under changing osmotic conditions, uninfluenced by any variation of electrical resistance, Shoji[82] (1919) showed that the propagation velocity, and therefore also the excitability, was at a maximum at the optimum physiological osmotic pressure, and that a higher or lower osmotic pressure acts in the same sense, decreasing the excitability and the propagation velocity in accordance with the amount of deviation from normal. Any effect of an injection of sodium chloride could only affect a nerve mechanism either chemically by virtue of the natrion itself, or physically, by osmotic change induced by the concentration of the ion. In both hypertonic and hypotonic injections the natrion is constantly present, and, moreover, a similar effect is induced by sugar; while any osmotic variation in either direction we have seen to have the same effect—decreased excitability, involving a potential vaso-dilatation with a consequent potential increase in tension; the observed changes in pressure were in opposite directions, and that induced by hypertonic solutions is of decreased tension. Their occurrence, therefore, cannot be explained on any assumptions involving a vaso-motor influence.

The variety of substances that may be employed to affect the change and their widely different chemical nature, strongly suggests that their action is merely one of physical concentration. The formidable list tried by Hertel has already been mentioned, and, moreover, this investigator demonstrated that their action can be correlated in degree with their equivalent osmotic activity.

The generality of the reaction in different parts of the body also points to the same conclusion. Mention has already been made of the closely corresponding results obtained by Weed and his co-workers in the cerebro-spinal fluid, observations which find clinical corroboration in the therapeutic lowering of intracranial pressure, in a manner exactly analogous to that shown to occur in the eye, which has been recorded in this country by Cohen[12] (1924), and MacBride and Carmichael[59] (1924), in America by Haden[32] (1919), Cushing and Foley[16] (1920), Sachs and Belcher[75] (1920), and Ebauch and Stevenson[22] (1920), and in France by Leriche[55] (1922) and Wertheimer[98] (1923). These results are all

the more interesting in view of the fact that vaso-motor nerves probably do not exist in the brain (*vide* Bayliss and Hill[7], 1895).* The same method, moreover, may be employed to reduce cardiac and renal oedemas (Henriques[40], 1914).

Having established that the general reaction is an osmotic one, there remains to examine its nature in detail. It is part of the attempt on the part of the body mechanism to retain normality in the osmotic level of its fluids, a function of considerable phylogenetic age and gradual evolution. The osmotic concentration of vegetable sap appears to vary largely with the nature and habitat of the plant, as is also the case in the tissue fluids of marine invertebrates. With the development of elasmobranchs stability in level begins to be attained, which is completed first in teleosts. From these onwards, all the higher animals, including man, while they vary somewhat between species, maintain, in defiance of alteration, an osmotic pressure approximately equal to what is computed to be the value of the sea water of the early Cambrian period. How delicate is the adjustment to this level is shown by the work of Hamburger[35] (1902), whose findings are corroborated by the observations of Cohnheim[13] (1912), Ginsberg[27] (1912), Haldane and Priestley[33] (1916) and White[99] (1920). The method of adjustment can be deduced from Starling's[85] (1896) work on lymph production. In the normal state the fluid traffic of the body is regulated by the equilibrium between the amount driven out of the circulation into the tissue spaces by filtration due to the blood pressure, and that transferred back into the blood stream by the effective osmotic pressure of the blood over the lymph due to the colloids of the former. On a hypertonic injection this osmotic pressure is greatly raised by the presence of increased crystalloid. Since an effective increase over filtration pressure is thus established, fluid is transferred in excess from the tissues into the blood, dehydrating the former, and increasing the volume and pressure of the latter. As salt equilibrium is quickly re-established, the effect is only temporary, but at the same time the lessening of osmotic resistance to filtration in the kidney by dilution of the blood colloids induces a great diuresis (Barcroft and Straub[2], 1910). The very large excretion of urine observed in the above experiments, involving much tissue dehydration and corresponding with the fall of intraocular pressure, is confirmed by the experiments of Meyer and Gottlieb[64] (1914), who found that by diminishing the colloid content of the blood, urinary excretion can be obtained at a pressure as low as 13 mm. Hg. It

* It should be noted that this finding is not unquestionably accepted by everyone. For anatomical evidence of the presence of nerves, see Gulland [30] (1897), Hunter [47] (1902); for physiological evidence (action of drugs), see Wiggers [100] (1907).

also explains the rationale of still another therapeutic field in which hypertonic injections have been applied, although the physico-chemical principles underlying have not always been appreciated —the establishment of urinary flow in oligurias and anurias (Fleig[25], 1907; Henriques[40], 1914; Turrettini[92], 1915).

Converse considerations are applicable to the effect of hypotonic injections. Thus on a purely osmotic basis may be explained all the systemic effects observed in the series of experiments.

The changes in intraocular pressure are explained partially by the osmotic inflow or outflow of fluid, the eye sharing the processes of dehydration or water-logging common to all the tissues. Hertel[43] (1914) was able to demonstrate this variation in water content by enucleating one eye prior to an injection, and enucleating the other subsequently, the weight of water in each being determined by weighing the eyes and their dried residue. In each case he found that the increased tension induced by a hypotonic injection was accompanied by an increased water-content, and that the decreased tension induced by a hypertonic injection was accompanied by a decreased water content. We have been able to show that the same mechanism obtains *in vitro*. The enucleated eye has a tension of 8 to 10 mm. of mercury (*cf.* Magitot[62], 1923) which it retains for some considerable time, and only loses gradually on the disintegration of the lining cells (12 to 15 hours). The same limit of pressure is obtained on killing an animal by exsanguination (Leber[54], 1903; Grünhagen[28], 1866; v. Schultén[77] 1884). Since it is found under these conditions it cannot be due to the blood pressure, and since it remains in the enucleated eye it cannot be due to any hypothetical secretory activity; it must be dependent on the relative physiological impermeability of the integral lining cells. If such an eye be placed in isotonic saline or serum it retains its internal pressure for some time and its weight remains constant. If it be placed in hypotonic saline it increases in tension and gains weight initially, while in hypertonic solutions it rapidly becomes of pulpy consistency and loses weight. It is thus clear that the eye is capable of functioning as an osmotic machine.

The intimate nature of the mechanism is, however, probably more complicated. Owing to its ready diffusibility, the salt concentration will soon be equalized on both sides of the cellular membrane and equilibrium will be attained. The fairly prolonged effect observed clinically and experimentally, outlasting the blood changes as detected by cryoscopy, may depend on one of, or all of, the three following factors: a change in rate of elimination of fluid, a change in rate of formation—or the establishment of a new ratio between these two—and a change in the amount of fluid retained.

A disturbance of the first is suggested by the fact that with hypertonic injections Angelucci[1] (1913) noted a diminution in rate of excretion by Leber's filtration manometer.

The second factor may be studied and the two compared, by the injection of dye-stuffs. An estimation was made, by experiment, of the circulation time in the cat by injecting methylene blue into the saphenous vein and watching, ophthalmoscopically, for its occurrence in the retinal vessels; an average time interval for its appearance was from 3 to 4 seconds. Uranin was then injected and the time of its appearance in the eye as fluorescein noted, the time when the entire eye showed the fluorescein tint, and the time when clear aqueous again became apparent. In the normal eye the dye appeared clearly in from 1.25 to 1.5 minutes, it had reached its maximum density in from 20 to 22 minutes, and had begun to clear up, as demonstrated by the appearance of a negative Ehrlich's line, in 45 to 50 minutes. After a hypertonic injection its appearance was delayed to 2 to 2.5 minutes, and the commencement of its disappearance to about 70 minutes. After hypotonic injections results so consistent were not obtained; as a rule they approached very nearly the normal. It would thus seem by this rough index of measurement that with the former, at any rate, the rate of both formation and elimination is retarded.

The factor of retention of fluid is probably more important, but, involving as it does a consideration of the capillary chemistry of the colloids of the eye, its nature is so complicated that it must be left to a future discussion.*

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* A partial indication of its probable mechanism may be deduced from some considerations involving the vitreous gel. The osmotic activity of a colloid at a given concentration and temperature varies with the nature and amount of crystalloid present, independently of the osmotic effect of the crystalloid *per se*. See Lillie[56] (1907), who found that in the presence of N/96 NaCl (a much lower concentration than we are concerned with), the osmotic pressure of albumen fell from 18.0 mm. to 6.8 mm. Hg. Also Roaf[72] (1907). The process may involve an increased aggregation of colloidal particles, the first stage of that which ultimately leads to complete precipitation (see Hardy[36] 1900; Freundlich[26] 1903). Again, where a system of colloidal ions and electrolytes are involved, forces of electrostatic potential must be considered. Compare the lowering of osmotic pressure with electrolytes found by Bayliss[4] (1909), explicable by a Donnan's[18] equilibrium (1911). Compare Pauli's[68] observations (1914) on the effect of salts on the state of aggregation of proteins interpreted in terms of adsorption equilibria. Compare also the influence of hydrogen ion concentration on colloid equilibria (Michaelis,[65] 1914), its relation to the addition of salts (Loeb,[57] 1922), and its co-relation to variations in intraocular pressure (Meesman,[63] 1924; Bauermann,[3] 1924). Fischer's[24] theory (1908) of acidosis and imbibition ("Quellung"), sometime fallen into disrepute, but periodically resuscitated, is clinically and physiologically untenable. The dramatic effects he obtained *in vitro* in the eye depend, not on imbibition (solid solution, capillary adsorption), but probably on the osmotic effect of ionizing salts of proteins; see Roaf[73] (1910), Siebeck[83] (1912), Bentner[9] (1913), Procter[69] (1914); and any such effect is diminished by the addition of salts, the electrolyte diminishing ionization.

VI. Conclusions

In their classical research on intraocular pressure, Henderson and Starling[39] (1906) concluded that "the production of intraocular fluid is strictly proportional to the difference in pressure between the blood in the capillaries of the eyeball and the intraocular fluid." In the light of the present investigation this finding must be modified, since it is seen that the pressure in the eye, while influenced by the pressure in the blood stream, can vary quite independently of it.

(1) The intraocular pressure is maintained and varied by three factors (neglecting the influence of external pressure):

(*a*) The physiological partial impermeability of the lining cells of the eye.

(*b*) The hydrostatic blood pressure in the capillaries of the ocular circulation.

(*c*) The osmotic pressure of the blood and of the ocular contents.

The relative potential importance of the osmotic over the hydrostatic component is seen in that the intensity factor of the former is of the order of 5,000 mm. Hg., or about forty times that of the physiological blood pressure.

(2) The physiological partial impermeability of the endothelial cells maintains normally a pressure in the intraocular fluids of 10 mm. of mercury. This pressure component is maintained without regard to changes in the hydrostatic pressure of the blood, but it may be overcome by osmotic changes therein.

The blood pressure in the capillaries is a function of the general systemic blood pressure and the local state of vaso-dilatation. The former is to be regarded as a composition of both arterial and venous conditions; of these two, since the arterial pressure is largely damped by the interposed arterio-motor mechanism, the venous pressure is normally the preponderating. Changes in the local state of dilatation are mediated in part by a nervous mechanism acting on the Rouget cells, in part by physical and chemical influences, locally determined, acting on the contractile elements of the capillary wall. Under the influence of changes in this pressure component, the intraocular pressure may vary to a maximum not higher than that of the capillary level, less the effective difference in osmotic pressure between the blood and the aqueous due to their unequal colloid content, and to a minimum not lower than 10 mm. of mercury.

The factor of osmotic pressure acts partially in the alteration of the rate of production and elimination of the intraocular fluid, partly by the alteration of the equilibria of the physico-chemical

activities involved in the dynamics of colloidal solutions. Under the influence of changes in this pressure component, the intraocular pressure may be either raised or lowered above or below the effective limits of variation determined by the blood pressure.

(3) Experimentally, the influence of the first factor is seen in the pressure decrement in the excised eye. The co-relation of the intraocular pressure with the blood pressure has long been recognized in the laboratory. Pressure variations caused by osmotic influences have now been demonstrated.

The alteration of intraocular pressure induced by the intravenous injection of anisotonic solutions is due, initially to changes in the hydrostatic capillary pressure, ultimately to changes in osmotic conditions.

(4) Pathologically a lowering of intraocular tension due to a diminution or abolition of the partial impermeability of the lining cells of the eye is seen as a result of the solution of the continuity of the endothelial layer that occurs physiologically in long-continued moribund states (for example, the hypotony of typhus) or that occurs anatomically after trauma, induced either accidentally, or therapeutically in a trephining operation, the filtering nature of whose scar depends on the failure in the formation of an endothelial lining on its inner surface.

The part played by the general blood pressure in the explanation of pathological tension states has been tried and found wanting: that played by the capillary pressure is still virtually an unknown quantity. The physiology of the capillary vaso-motor mechanism is still in its infancy, but recent investigations (Krogh[52]) on its response to mechanical and chemical stimuli, to changes in the osmotic and hydrogen ion concentration of the surrounding media, and to the action of the hormones elaborated by the endocrine glands, are full of significance.

The action of osmotic pressure in the production of pathological hypotony is seen in the soft eye of diabetic coma. The part played in the production of pathological hypertension by osmotic pressure and the many physico-chemical relations it controls has as yet been comparatively unexplored. As all normal bodily processes rest ultimately on their reaction, so must we look to their biological application for a rational explanation of those departures from normal which we recognize as disease, and the therapeutics of perfection becomes the re-establishment of equilibrium in terms of chemistry and of physics. The two major diseases of the eye —cataract and glaucoma—are patent examples of physico-chemical derangement. The latter cannot be ultimately explained on an anatomical basis, and to treat it as if it were, by the modern filtration operations can only be considered an expedient. In this

connection the opinion of Sir John Parsons expressed in the Bowman Lecture (1925) is apposite: further advances in ophthalmology will not be along the lines of improvement or elaboration of operative technique, but rather by a fuller understanding of the biochemistry of the eye and of the physiology of vision.

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OSMOTIC THERAPY IN GLAUCOMA

BY

W. S. DUKE-ELDER

LONDON

DESPITE the fact that the possibility of lowering the tension of the eye by altering the osmotic condition of the blood has been known for some considerable time, the literature of cases so treated is scanty. To Cantonnet[3] (1904) belongs the credit of first employing this method of therapy in glaucoma. Under the influence of the work of Winter[22] (1896) who, contemporaneously with Starling[18] (1896), was the first to show the importance of chlorides in the maintenance of the equilibrium of the body-fluids, and stimulated by the investigations of Achard[1] (1903) and Loeper[13] (1903) on the upset of that equilibrium caused by deranged renal excretion, he treated 17 cases, with good results in 12, by the oral administration of salt.

The experimental work of Hertel[10] (1914) has already been referred to: in 1913, he published three cases, and again, in 1915, a further small series treated successfully by the injection of 150 to 200 c.c. of a 10 per cent. solution of salt.

Following his technique, Pletnewa[15] of Moscow, (1923), described a series of 20 cases treated intravenously with good results; one of three cases to which salt was given orally (30 gms.) reacted.

Weekers[21] (1923) has tried the method. At an earlier date (1912), following on the work of Chiari and Januscke[4] on the inhibitory action of the calcium ion on exudation and transudation, he had used calcium chloride subconjunctivally in glaucoma, an idea which was followed up by Tristaino[20] (1913), Gowland[8] (1916), Alt[2] (1918) and Kleiber[11] (1922) with subconjunctival and systemic administration of this salt; but the results were inconclusive (Weekers[21], 1920). Giving up its use in favour of sodium chloride administered intravenously on osmotic principles, the latter (1923) treated 13 cases by the injection of 5 c.c. of the 30 per cent. solution: in 7 acute glaucomas the tension was markedly reduced for a period of two to three days, but the response in the other varieties of the disease was not so marked. Considering the smallness of the dose employed this is not to be wondered at.

By the prolonged and continuous intravenous injection of sugar, Sansum[19] (1917) succeeded in obtaining a marked reduction of tension in two cases.

The following is a short note of an initial series of four cases of glaucoma, treated by an intravenous injection of concentrated salt solution. I am indebted to Mr. A. C. Hudson for the

privilege of availing myself of them from his clinic at Moorfields Hospital.

(1) Female, aged 47 years. Chronic glaucoma, L. T.R.= 30 mm. Hg. (Schiötz), T.L.=45 mm. Hg. 35 c.c. 30 per cent. NaCl. intravenously in 10 mins. T.L. in 30 mins. became 12 mm. Hg.: in 1 hour=11; in 6 hrs.=8: next day=16: the following day=20 mm. Hg. T.R. in 30 mins. became 15 mm. Hg., and remained so up to 6 hours: next day=18 mm.: the following day=29 mm. Thereafter, L.E., trephine: R. eserin.

(2) Male, aged 54 years. Subacute glaucoma, R. T.R.= 53 mm. Hg. T.L.=29 mm. 50 c.c. 30 per cent. NaCl. intravenously in 10 mins. In 45 mins., T.R. and T.L.=27 and 15 mm. Hg.; in 75 mins=25 and 18 mm.: next day—T.R.=30 mm.

(3) Female, aged 61 years. Acute glaucoma, L. L.V.=p.l. Much pain. L. cornea hazy: fundus not seen. T.L.=95 (approx.) mm. Hg. 50 c.c. 30 per cent. NaCl. intravenously in 10 mins. In 30 mins. T.L.=80: in 1 hour=52 mm. Hg. L. cornea clear; retinal haemorrhages seen: L.V. 6/36: (pain away). In 6 hours, T.L.=38 mm. Hg. Later, trephine, L.

(4) Male, aged 29 years. Trauma L. eye—traumatic glaucoma. Cornea hazy; aqueous turbid, with floating red cells (by slit-lamp); iris showing several small haemorrhages on anterior surface; lens, position normal, iris pigment on anterior surface. Much pain. T.R.=25, T.L.=58 mm. Hg. (Schiötz). Three days later, despite eserin, leeches, etc., condition unchanged. 50 c.c. 30 per cent. NaCl. intravenously in 10 mins. 15 mins. later —T.R. and T.L.=10 and 30 mm. Hg. respectively. In 1 hour=10 and 15 mm.: in 6 hrs.=5 and 12 mm.; in 10 hrs., 5 and 14 mm.; in 48 hours 15 and 20. Three days later, 25 and 30 mm. at which level the tension remained for some months. The long-continued (? permanent) improvement here may have been due, either to the fluid traffic set up washing away red cells and other detritus from the filtration angle, or to the relief of tension allowing the recovery of tone in a possible vaso-motor paralysis induced by the trauma.

Technique used. Since the effect is a general one depending on increased molecular concentration independent of the nature of the molecules, the injection substance used is of secondary importance. Common salt would appear to be the most suitable, because of the ease and cheapness with which it is obtained and can be sterilized, because of its high osmotic power, and because it is comparatively non-toxic: normally its function in the economics of the body is that of the currency of water traffic, in that, without being in itself of intrinsic metabolic value, it

regulates and permits of the exchange of fluid. A 30 per cent. solution was employed, intsead of the 10 per cent. solution used by most of the previous investigators. The former is better, since being a concentrated solution (the solubility of NaCl. is one in three) it is easily prepared without weighing, and can therefore be made up in any emergency, and the smaller bulk of water introduced makes the desired effect of dehydration the more powerful. That the standard of injection must be a relative velocity-weight has been pointed out in the previous communication, and the experimental lethal dose in cats obtained at about 1.5 gms. of salt per kilo. body weight introduced at the rate of 1 c.c. per minute. A dose of 1 c.c. per kilo. body weight (that is, an average adult dose of about 50 c.c.) of a 30 per cent. solution, injected slowly and evenly over 10 minutes, keeps within this value, gives the desired therapeutic effect, and has never given rise to anxiety.

The injection was made with the patient lying down, in case of any fall in blood pressure, and the salt solution was given (finally) through a needle attached to a rubber tube and funnel. It is difficult to feed regularly and slowly from a syringe, and, syringes of sufficient size not being usually available, it is easy to allow the point of the needle to leave the lumen of the vein in repeated recharging. This is important, for the presence of concentrated salt in the connective tissue is exceedingly painful, and leaves a brawny, indurated, painful swelling which persists for many weeks. For this reason the needle and lower end of the tube were filled first with normal saline, so that on its introduction none of the concentrated solution reaches the tissues, and if the funnel be held just at the level of the vein, a sufficiently slow and uniform flow is ensured with no disturbance whatever. After the injection the patient can get up at once. He will express the desire to drink, but no water should be given him; and he will suffer from polyuria.

The lowering of intraocular pressure thus obtained is transitory, lasting at most a day or two. There is no contra-indication to a second injection, but if any more prolonged effect is desired, the exhibition of salt by the mouth in cachet form, or by the rectum might be considered. Much larger doses would require to be given; the effect is less certain and less marked; and, in the usual type of glaucomatous patient, it would be advisable in any prolonged medication to estimate the renal efficiency and the chloride threshold as a precautionary measure.

The Dangers of Hypertonic Injection. The dangers of hypertonic injection are two-fold: the initial sudden drop in blood pressure, and the subsequent dehydration of the tissues. The

first can be overcome, as has been demonstrated experimentally and experienced clinically, by ensuring that the injection be made slowly enough. With this precaution not one of the patients that have been injected experienced any discomfort. The danger may be entirely obviated by adopting the alimentary route of administration, but the disadvantages of this method have already been pointed out.

The second danger—that of general dehydration—is a necessary effect of the success of the method of therapy. Considering the elaborate and delicately adjusted mechanism for the maintenance of the water-balance, it is surprising how little discomfort is felt after an injection within the limits proposed, beyond a sensation of thirst. Pushed to extremes, however, serious consequences ensue. Rubner[17] (1907) has shown that, while an animal can lose practically all its glycogen and fat, 50 per cent. of its protein, and 40 per cent. of its body weight and yet live, a loss of 10 per cent. of its water content results in serious disorders, of 20 per cent. in death. The premonitory signs of too great water starvation are a general restlessness and tremor, a feeling of numbness and tingling followed by twitching and cramps in the limbs, a sinking in the abdomen, a vague sense of fear, and a rise of temperature—a condition easily combated by the free administration of fluid. It is seen clinically in the febrile attacks ("inanition fever") Crandall[5] (1899) of dehydration states in infancy, a condition dealt with by Heim and John[9] (1910), and Peteri[14] (1914) from the clinical standpoint, and studied experimentally by Finkelstein[7] (1908) by the massive injection of glucose, and by Woodyatt and Rowntree[16] (1922) by the injection of salt, the latter observers causing coma, convulsions, and death, with a final temperature of 110° F.

The opposite condition induced by hypotonic injections is of less clinical interest (*cf.* Weekers[21], 1924). The initial danger is one of haemolysis, the subsequent one, of water intoxication. The latter is seen clinically in the effects of diabetes insipidus, and its nature and effects have been largely studied by Rowntree[16] and his co-workers (1922).

Clinical Indications. It would appear that osmotic therapy might be indicated:

(1) In conjunction with miotics as a means of tiding over an acute case of glaucoma until such time as operation can be undertaken conveniently. An emergency operation is in many cases undesirable in that a skilled operator is not always immediately available, the most propitious surroundings are not always obtainable, and the condition of the patient is not always suitable

for a major surgical procedure. A measure simple in its application and efficacious in tiding over a crisis would seem to have something to be said in its favour.

(2) In conjunction with miotics, as a preliminary to operation. In conditions of high tension operation is often difficult owing to vascular congestion, and bears an element of risk from accidents (expulsive haemorrhage, etc.), while local anaesthetics are absorbed with difficulty, a circumstance often rendering general anaesthesia with its attendant discomforts advisable. With the tension lowered beforehand a difficult procedure becomes an easier one, and the risks and discomforts are minimized.

(3) In conditions of raised tension with iritis where hesitancy is felt in ordering atropin.

(4) As an aid to diagnosis when the clouded cornea of raised tension precludes ophthalmoscopic examination.

(5) As a possible aid to therapeutics. This is suggested by the observations of Knapp[12] (1909), Crondstedt[6] (1924), etc., who found that the ocular fluid re-formed after paracentesis, that is, under the changed conditions of lowered tension, contained a much higher percentage of bactericidal substances than the normal aqueous. That the aqueous re-formed under these conditions contains a higher proportion of protein is well known. All recent work tends to show that the various substances concerned in immunity are of a colloid nature and are susceptible to the laws that govern the behaviour of colloids, while the size of the particular units of at least one of them (diphtheria toxin) has been estimated* to be very nearly approximating to that of serum albumen (of the order of 3×10^{-6} mm.) Therefore, in common with protein, while under conditions of normal tension they are present in the aqueous only in negligible amount, their more ready entrance into the eye from the blood stream is to be expected on the provision of a steeper pressure gradient. Even in an eye with normal tension, and much more so in conditions of raised tension (iritis, corneal ulcer, etc.), when pressure conditions militate against the access of any substances in colloidal aggregation, such a procedure might be indicated, acting after the manner of a therapeutic paracentesis. It might also be suggested that therapeutic substances, such as arsenic, which normally find their entrance into the eye with difficulty, might gain access to the

* By ultra-filtration ; see Bechold, *Zeitschr. Physik. Chem.*, lx, 257, 1907 ; lxiv. 328, 1908 ; also Ostwald, *Kolloid Zeitschr.*, xxii, 72, 143, 1918 ; Zsigmondy, *Zeitschr. Anorg. Chem.*, ciii, 119, 1918. This deduction should not be taken too literally, since, in addition to an atomic sieve action, other factors must be taken into account in the mechanism of the permeability of membranes ; capillarity, adsorption, preferential solubility, chemical affinity, etc.

intraocular fluids the more easily under the influence of the increased fluid traffic set up after an osmotic dehydration.

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THE SCLERAL STITCH IN ADVANCEMENT OPERATIONS

BY

W. DUNCAN LAWRIE, M.D., F.R.C.S.E.

STOKE-ON-TRENT

THE modification in the grip of the needle-holder shown in the illustration, combined with the use of Worth's straight cutting scleral needle, will be found to enable the scleral stitch to be inserted with lightness and ease.

The grip is as in holding a pen, with the exception that the middle finger takes no part in it. The holder used is the one

which goes by the name of Landolt's, but that is not essential. It is introduced from above the orbital margin by the right hand when working from right to left and by the left hand when working from left to right, or when working from left to right the instrument may be used from below with the right hand. The needle is fixed in the holder so that the flat surface of its cutting end can be readily placed on the sclera parallel with its surface. The method allows a light hold and the forefinger does the work of supplying the necessary pressure.

Better practice can be got in passing the needle on an ordinary thin postcard such as is sold in packets of ten a penny than on a pig's eye.

NOTE.—Since writing the above Messrs. John Weiss & Son have made a needle-holder for use in this operation, which has the advantage of lightness and ease of release, after the pattern of Worth's advancement forceps.

In inserting the scleral stitch in advancing the left external rectus it is best to stand in front and on the right side of the patient; and to stand behind the patient in the case of the right external rectus. During the preliminary part of the operation, as far as and including the division of the muscle, stand behind for the left external rectus, in front and on the right side for the right external rectus. For practice in inserting the scleral stitch, paper of the thickness and quality of many advertisement pamphlets is better than a post card, and a good deal of practice is necessary.

COUNCIL OF BRITISH OPHTHALMOLOGISTS

Report on the Methods adopted in various Parts of the British Isles for the education of children suffering from defective vision due to Myopia or other causes (excluding the Blind).

The Council excludes from consideration those children who, on reaching adult life, will probably be economically blind, that is, "unable to do work for which sight is essential." In the opinion of the Council such children should be educated in schools for the blind.

The Council considers that special educational facilities are required for those who have defective vision, and for whom the ordinary school education is unsuitable, *e.g.*, cases of progressive myopia, defective vision due to corneal opacities, congenital abnormalities, etc.

Classes which give the required facilities exist, and are termed by the Board of Education "schools for the partially blind." The Council thinks that this term is very undesirable; it gives offence to parents, and may leave a stigma detrimental to the child in after life. The term "myope class" is already in use, and connotes the purpose for which this form of education is designed. Such classes were established by the London Educational Authority in 1908. It has been found that the best interests of these children are served if such classes are held in association with elementary schools, because the oral teaching and physical exercises given in the ordinary classes are available for the children. By this system association is fostered between the defective-sighted and normal children.

As the children in these classes are of various ages and educational standards individual teaching is essential, and therefore, it has been found advisable to limit the number of children in each class.

The system of teaching by means of "myope classes" may seem to limit education so far as high scholastic attainment is concerned, but it has been found undesirable to encourage these children to follow a higher education, with the prospect of a sedentary occupation, thus incurring grave risks of serious breakdown later in life.

The Council has been informed that in London there are now forty-one "myope classes" providing accommodation for 915 children. In the rest of England, according to the latest information available (Report of Board of Education, 1924, list 42), there are four "myope schools," and provision for other

defective-sighted children is made in special classes and in schools for the blind.

With a view to obtaining further information a questionnaire was sent to ophthalmic surgeons practising in seventy-six areas of England, Scotland and Wales, excluding London, with the following results:

QUESTIONS.	RESULTS.
1. Are the school children under the Educational Authorities of your district examined with regard to visual acuity, and those with defective sight systematically examined and treated by spectacles (when required) by a qualified ophthalmic surgeon?	All children are examined with regard to visual acuity. In nine areas no treatment is provided; in all others spectacles are ordered by an ophthalmic surgeon when required.
2. The number of special schools for children with defective vision.	Sixteen such schools or classes exist in nine areas.
3. The number of classes for these children attached to: (*a*) Blind Institutions. (*b*) Ordinary Elementary Schools.	Seven are located in blind institutions. Nine are some form of special class or school. No special school or class is provided in sixty-seven areas.
4. In country districts where there are not sufficient children to form a "myope class," is any provision made for their education?	In one area the children are sent to special educational centres. In two areas teachers are trained in the principles involved in the education of myopes, and special desks, with blackboards attached, are provided. In one area special instruction is given to head teachers. In one area all children with high or increasing myopia are restricted in their work, the most seriously affected cases being excused school for varying periods, the teachers being advised about the kind of work which is suitable for them on their return.

The Council realizes that the inquiry has not been exhaustive, but considers that it demonstrates that, with a few notable exceptions, the provision for the education of the affected children is seriously inadequate.

It is obvious that in country districts where the number of defective-sighted children is insufficient to form special classes, some provision should be made either to send them to one of those classes in the nearest town or for their teachers to receive instruction in their management.

The Council strongly endorses the recommendation of the Departmental Committee on the Causes and Prevention of Blindness "that further provision should be made by education authorities for the education in myope classes or by similar methods for children with serious defects of vision requiring such facilities, and that steps should be taken to discover these cases at such an early age as will allow of preventive measures being adopted." (Report of Department Committee, p. 53.)

The Council therefore recommends that:

(1) Children with defective sight should be examined periodically by an ophthalmic surgeon, who should prescribe the necessary treatment and educational regime.

(2) In all large centres of population special classes should be established for children with such defective sight as renders them unsuitable for ordinary school education. These classes should be associated with the ordinary elementary schools, and limited to a nominal roll of twenty children to each class.

(3) In country districts where there are not sufficient children to form a "myope class," instruction should be given to teachers and parents on the education and management of children with defective sight.*

Parents and Local Care Committees should receive advice as to the choice of occupation for the children on leaving school.†

ANNOTATION

Artificial Daylight

The great advantages obtainable by the use of light, suitably altered to give results similar to daylight, both in commerce and the arts, have so far only been obtainable by two methods, both of which require a costly installation. In one of these the light is suitably modified by the use of screens, and in the other by

*The following pamphlets issued by the London County Council contain suitable instructions for teachers and parents:—

(a) Hints for Teachers of Myope Classes.

(b) Memorandum containing advice to Parents of short-sighted Children who have been recommended for admission to a Myope Class.

(c) Teaching of Children recommended by the Medical Officer for "Easy Treatment," "Oral Teaching Only," or to "Sit in the Front Row."

†See papers by Bishop Harman. *Proc. Roy. Soc. Med.*, 1915, Sec. of Ophthal., p. 120.

means of reflectors. Both methods have proved successful where the results obtainable justified their installation, as in drawing offices and in the commercial matching of colours.

According to *The Electrical World*, attempts are now being made to deal with the problem by using spectacles made with a special glass, the invention of which is credited to Dr. Hermann Weiss, of Vienna. We presume that such a method can only be applied to some definite source of light, such as an arc lamp. If practicable it would render it possible to enjoy a picture gallery even in a November afternoon in London. It must, moreover, be remembered that methods of obtaining "artificial daylight" which depend on screens require a very powerful source of illumination, which is not only costly, but also may easily cause damage to the pictures. We look forward with interest to hearing how the inventor proposes to get over the obvious difficulties, such as the prevention of light from outside sources reaching the eye and the correct standardization of the screening medium to the various sources of light in use.

ABSTRACTS

I.—HEREDITARY DISEASES

(1) **Truc (Montpellier) and Opin (Toulon).—A long-established centre of night-blindness in Provence. (Congenital familial hereditary night-blindness; the Nougaret of Vendémian type.)** *Arch. d'Ophtal.*, August, 1925.

[Readers of this communication may remember that the late Edward Nettleship and Professor Truc were associated in the investigation of the important genealogy of congenital night-blindness commonly known as the Vendémian pedigree, which was begun by Cunier and recorded by him in 1838. The completed pedigree was published in the *Transactions of the Ophthalmological Society of the United Kingdom* in 1907, and in the *Bulletins de la Société française d'Ophtalmologie*, 1909.]

(1) **Truc** and **Opin** have discovered more or less accidentally, another centre of congenital hereditary night-blindness, with precisely similar characteristics, and have published the pedigrees of several families affected by this abnormality.

The case which first came under observation was a female, a native of Néoules, Department of Var. She informed the authors that others in her part of the country suffered from a similar disability;

the affected persons were known as "sournières," *i.e.*, unable to see at night or in the dusk, from a local term "sourn" = sombre. The authors suggest that this village may possibly have been the original centre of the familial night-blindness of Vendémian, of which the first known example, Jean Nougaret (1637-1719) was known as "le Provençal." He may have been a native of Néoules but on this point evidence is lacking. Vendémian and Néoules are not far apart; both are in the old department of Provence, now subdivided. Néoules, a village of 300 inhabitants, is situated midway between Toulon and Brignolles, in a locality which, until the advent of the motor car, was very isolated. The inhabitants are almost all well-to-do agriculturists, some of them enriched by viticulture. As at Vendémian they are country folk who, by force of circumstances, have been relatively isolated. For this reason doubtless, the hereditary visual defect of which they are subjects, has been transmitted and reinforced by numerous consanguineous marriages. It is widely known in the department of Var that natives of Néoules are night-blind. Parents in this district examine their children's sight at an early age to ascertain if they are affected. In the examination of recruits for military service young men from Néoules, by reason of this defect, have been relegated to auxiliary services. In contrast to the Vendémians the night-blind inhabitants of Néoules make no endeavour to conceal their defect and submit willingly to ophthalmoscopic examination.

The genealogies now published contain 142 individuals, 42 of whom suffered from night-blindness: 17 of these are living and 8 have been examined by the writers. The cases are grouped in 6 families; their pedigrees are given in the accompanying tables:

		Persons	Night-blind.
I.	1791-1802—Emeric Bourguignon ...	37	15
II.	1800-1873—Jacques Long	21	7
III.	1785-1854—Emeric Augier	53	7
IV.	1810-1892—Bazile Long	15	8
V.	1846-1916—Jeanne Monin	5	3
VI.	*1809-1889—Augustine Monin ...	16	3

The authors have been unable to obtain information dating back more than a century. The identity of names indicates clearly that numerous alliances have been contracted among these families, but it has not been possible to follow the pedigree far enough to find a common ancestor from whom the defect has been inherited, as was so strikingly the case at Vendémian.

* There appears to be some discrepancy between the numbers in the general statistics and the totals of the 6 families as given by Truc and Opin.

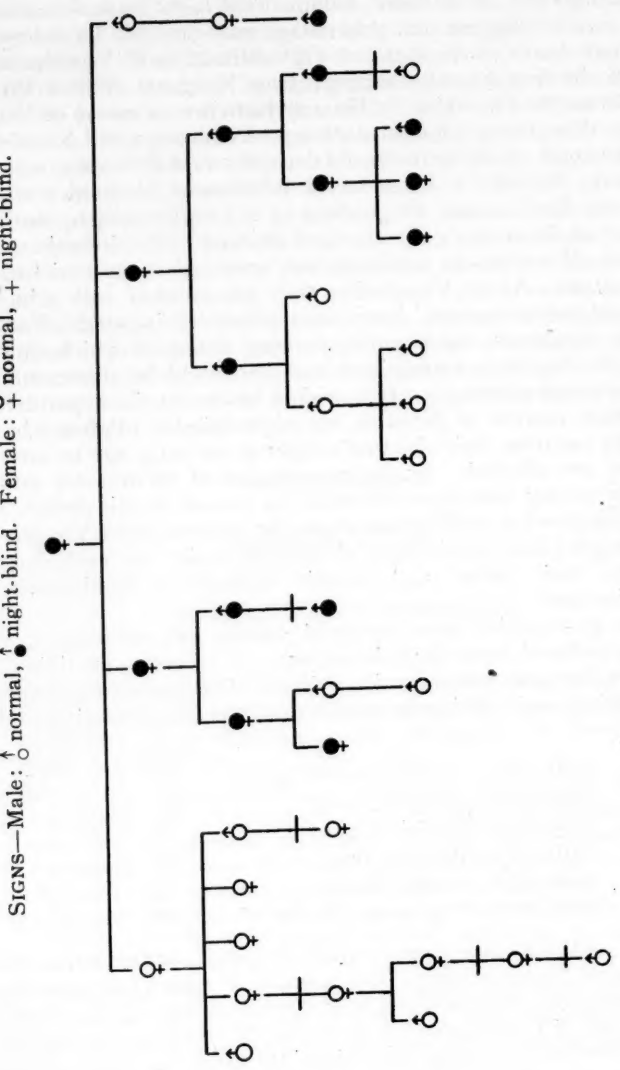


FIG. I.—EMERIC BOURGUIGNON.

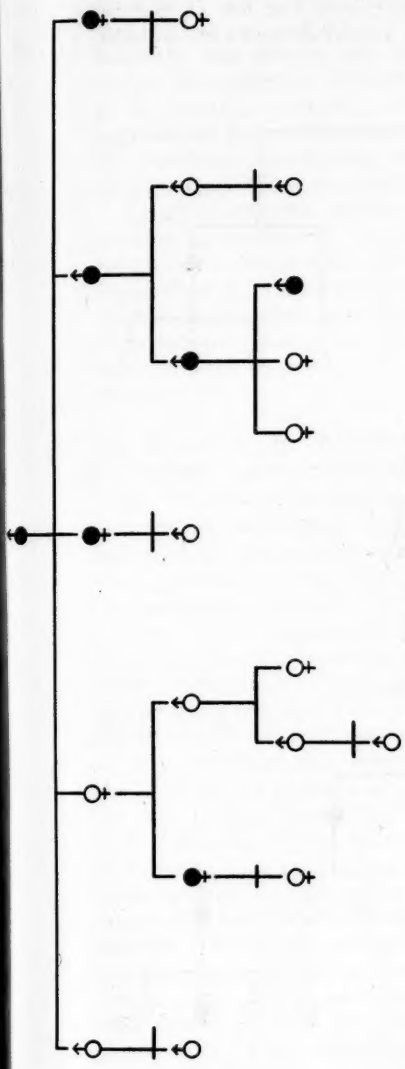


FIG. II.—JACQUES LONG.

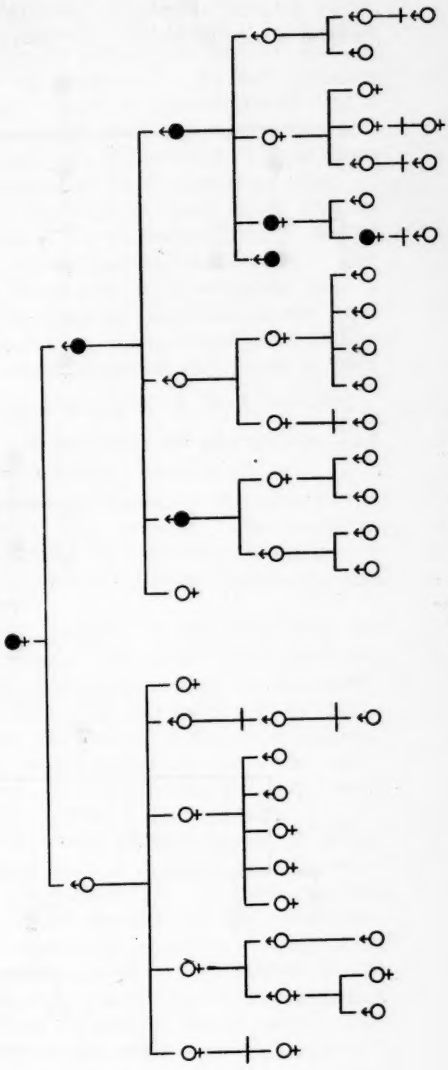


FIG. III.—EMERIC AUGIER.

All the individuals examined by the authors were free from other defects. Errors of refraction were few and low in degree; central acuity of vision was good; no mental defects were present.

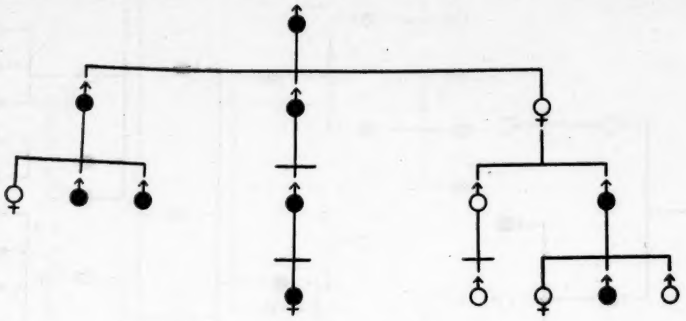


FIG. IV.—BAZILE LONG.

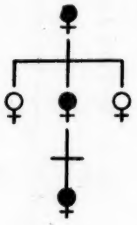


FIG. V.—JEANNE MONIN.

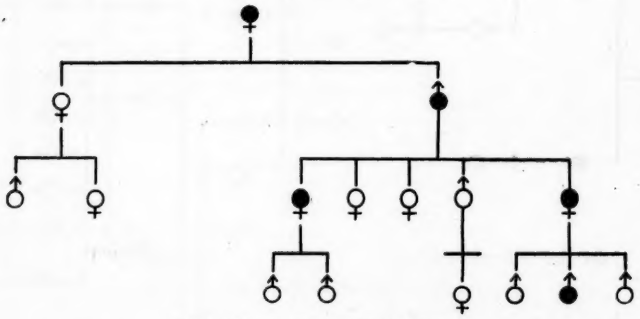


FIG. VI.—AUGUSTINE MONIN.

As at Vendémian the defect proved to be uncomplicated night-blindness, congenital, familial, hereditary, transmitted by either sex. The children of night-blind individuals, if free from the defect, never transmit the abnormality to their offspring. One

of the pedigrees, No. IV is apparently not in agreement with this statement; in it a healthy female, in generation II, had a son who was night-blind and his son was also affected. Later information, however, has shown that the female reputed to be free was in reality the subject of the defect. In pedigree No. II there appears to be a similar example, a healthy female in generation II had a night-blind son. This female has been dead for many years and the statement concerning her could not be verified. It is more than probable that an error occurred as in the previous case.

At all events the authors feel justified in their belief that in relation to hereditary transmission the characteristics of night-blindness at Néoules are the same as those at Vendémian. The suggestion by the writers that Nougaret of Vendémian was a native of Néoules, and that the cases of night-blindness now recorded are among his descendants is not unreasonable. The authors hope to pursue their investigations on this point in both districts.

J. B. LAWFORD.

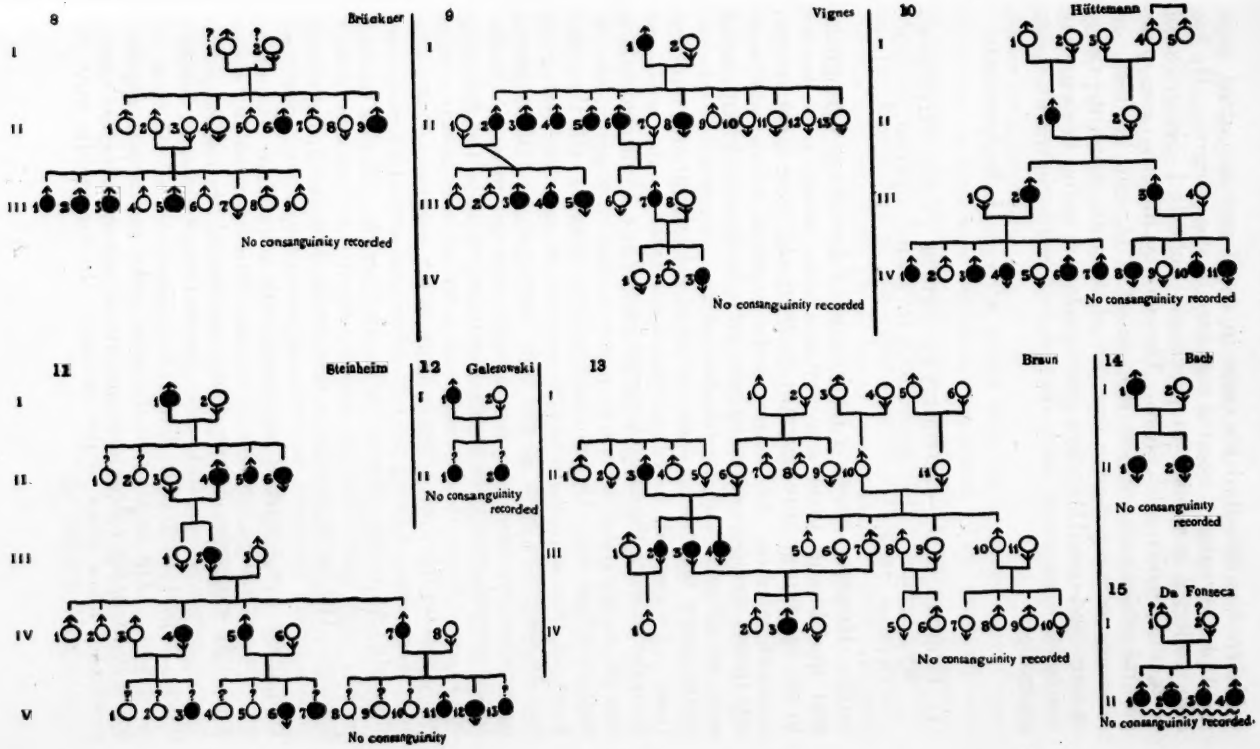
(2) **Usher, C. H (Aberdeen).—A pedigree of epicanthus and ptosis.** *Ann. of Eugenics*, Vol. I, Pts. 1 and 2, 1925.

(2) In this paper **Usher** makes a valuable contribution to the records of hereditary epicanthus and ptosis. The pedigree includes six generations and "shows epicanthus and ptosis in four generations (3-6), and transmission by both continuous and discontinuous descent."

The form of epicanthus in this pedigree is that described by von Ammon as *epicanthus palpebralis*, and is the same in all the affected members. There are 18 members showing the deformity in the pedigree, and Usher has been able to examine 14 of them. In all the 14 bilateral epicanthus was present with one exception, a boy in whom this deformity was present on one side only. In 13 of the 14 ptosis was present; it was bilateral in all but one. In case 14 there was bilateral epicanthus but no ptosis.

The accompanying chart shows "that 15 individuals (6 males, 9 females) with epicanthus and ptosis are descendants of a male with epicanthus and ptosis in generation III. In each case the anomalies have been derived from an affected male by continuous descent. In the remaining two cases in the pedigree the anomalies have not been derived by continuous descent. One of them (V, 29) has normal parents and his paternal grandfather has epicanthus and ptosis, so that the congenital anomalies have missed one generation. The other (VI,4) has normal parents, but his mother's paternal grandfather has epicanthus and ptosis and the congenital anomalies have passed over two generations." The author notes that these two cases differ in some respects from those in which the inheritance is direct.

Usher
1
I
II
III
IV
V
VI
* Dead
+ Seen
No consanguinity
2 Schmidgall
No consanguinity recorded
3 Alvarado
No consanguinity recorded
4
5 Marr
No consanguinity recorded
6 Braun
No consanguinity recorded
7 Braun
No consanguinity recorded
Settler
No consanguinity recorded


8
Brückner
No consanguinity recorded
9
Vignes
No consanguinity recorded
10
Hüttemann
No consanguinity recorded
11
Steinheim
No consanguinity
12
Galeszowski
No consanguinity recorded
13
Braun
No consanguinity recorded
14
Bach
No consanguinity recorded
15
De Fonseca
No consanguinity recorded

Usher has described his cases in detail and has added some good photographs of affected members of the pedigree. He has also collected a number of previously published pedigrees of epicanthus, mostly with ptosis. These follow his own cases in the general tables and are here reproduced. It will be seen on reference to the pedigrees that one of them (9) shows the defect in four, and one (11) in five generations. A useful bibliography concludes a paper of much interest in the inheritance of ocular anomalies.

J. B. LAWFORD.

(3) **Hemmes, G. D.—Hereditary nystagmus. Ueber hereditären Nystagmus.** Abs. *Zentralb. f. d. gesam. Ophthal.* (Dutch). October, 1924.

(3) **Hemmes** shows a family tree of hereditary nystagmus, and in addition gives a survey of all the family trees known in the literature, thirty-seven in number. In these there are two types of heredity. In one group the condition affects both male and female members without preference. In the other group, males only are affected and the females are the transmittors. In the mixed group one cannot speak of either a dominant or a recessive type. In general, heredity from the mother to the sons, and from the father to the daughters prevails. Thus, 28 affected fathers had 88 daughters of whom 61 per cent. had nystagmus, and 50 sons of whom only 18 per cent. had the disease. On the other hand, 28 affected mothers had 70 sons with 64 per cent. nystagmus and 34 daughters with 35 per cent. nystagmus. Often second generations are missed so that definite rules cannot be laid down. In the second group where sex is selected we have the following conditions: From the marriage of a female transmittor with a healthy male there were descendants to the number of 136 males and 90 females. Among these 96 males and only one female were affected. As a rule affected males and healthy females produce healthy and latent affected females, equally. The sons remain healthy. The latent disposition can remain dormant through many generations. Mixtures between the two groups were observed. Hereditary nystagmus is associated with a low hair boundary, pigment anomalies, and head-shaking. This head-shaking shows itself only sometimes during those activities which require greater mental concentration, and ceases generally as the patient becomes older. Apart from the diminished visual acuity there is no complaint. On looking to the side, jerky nystagmus appears, so that in order to compensate this a correspondingly slower movement takes place to the mid-line. In the middle zone the

eyes do not exhibit any movement, or there is an oscillating nystagmus. This mid-zone does not always lie in the mid-line, but sometimes a little to the left or to the right. In another group the zone does not remain constantly in the one situation, thus, if the direction of vision is slowly turned to the extreme right from the left, it lies more to the right. On the other hand, if the direction is from right to left it lies more to the left. After a sudden large alteration in the direction of vision, the nystagmus sometimes ceases for a period.

In twenty-seven cases the media were clear. Seven cases were examined for scotomata but none were found. The blind-spot was mapped out. In one case this was not possible. Eight cases were examined carefully for central scotomata, and while this was carried out the movements of the eyeballs were arrested by the finger. By this manoeuvre the visual acuity was sometimes improved and on the other hand was sometimes made worse. Round spots of 2.5 mm. in diameter were usually recognized at one metre. Of twenty-seven cases examined, in no case was the visual acuity found normal. Probably the retinal picture is not a clear one on account of the continuous movement. Hemmes comes to the conclusion that the origin of hereditary nystagmus does not depend on the pathological condition of the eyes. He nevertheless considers it remarkable that astigmatism occurs in 64 per cent. of all nystagmus cases known in the literature. He is of opinion that this might be brought about by the continual pulling of the muscles. An excessive irritability of the labyrinth was not found but rather the contrary. Sometimes the two types of nystagmus are connected, but in other cases caloric irritation produced no influence. Sometimes the three most important labyrinth reflexes, deviation of the eyes, loss of orientation, and falling down, were only partially present or they were elicited more easily from one ear than from the other. According to statements in the literature, many persons with hereditary nystagmus are indifferent to turning movements. The function of the otoliths throughout is diminished. This brings the author, who is a supporter of the Quix otolith theory, to the supposition that the diminished function of the otoliths is the cause of nystagmus.

The last chapter is devoted to the occurrence of hereditary nystagmus in the Netherlands. In four years, among 220,802 recruits, 117 were rejected on account of nystagmus. Hemmes was able to follow up 56 of these cases and ascertained that in 21 the condition was hereditary. He estimated that one case of nystagmus occurs in 5,032 recruits, and as nystagmus is rarer in women he estimates that one case occurs in 6,500 inhabitants.

S. SPENCE MEIGHAN.

(4) **Report of Committee on hereditary blindness. Section of ophthalmology.** *Jl. of Amer. Med. Assoc.*, May, 1925.

(4) The Committee, of which Lucien Howe was a member, had to consider what form of law could be proposed that would prove the most practicable and efficient to lessen the continued propagation of hereditary blindness. Apparently only three methods have been suggested, the first two of which are impracticable at the present time, namely, sterilization, and separation of man and wife; the third is by legislation as will be explained. It would be by amendment of the domestic relation law in such States as it already exists, in empowering the authority who issues marriage licences to require a written statement from the parties in the following words: "Neither myself nor, to the best of my knowledge and belief, any of my blood relatives within the second degree, have been affected with blindness. If so, I have been examined by, and submitted evidence in respect to such members of my family, to a physician or expert in heredity, and his report shows that it is improbable that such blindness was transmissible by heredity." The authority may examine such experts under oath to satisfy himself of the truth of their evidence, and he may refuse to grant the licence unless the applicant signs a bond for an amount to be fixed by the authority, and filed with the Treasury. If a child born of the marriage becomes chargeable to the State, the cost thereof becomes chargeable against the signatory to the amount of the bond.

A. F. MACCALLAN.

II.—TRACHOMA

(1) **Morax, V.—The aetiology of the social plague, trachoma.** (L'etiologie du trachome, fléau social.) *Revue du Trachome*, July, 1925.

(1) This is an address delivered by **Morax** at the inaugural meeting of the Brussels Congress in May, 1925, which was honoured by the presence of Her Majesty the Queen of the Belgians. It is a very interesting review of the world-wide distribution of trachoma and of our clinical and bacteriological knowledge of this disease. In spite of the great number of bacteriological researches made in every country the aetiological agent is still unknown. Its discovery would, of course, be a great advance, but we know from the study of several infections, such as smallpox and rabies, that it is not absolutely necessary to know the parasitic agent of an infection before investigating the aetiology, the prophylaxis, or the treatment.

The incubation period after contact with trachomatous secretions proved to be eight days in the case of MacFetridge, Assistant Surgeon to the Royal Victoria Eye Hospital, Dublin, who unfortunately infected himself while expressing granulations. In his case the other eye did not become infected for six months. Meyerhof, a very careful observer, gives four to six days as the incubation period. It is not given to many surgeons, who have much trachoma to treat, to have the opportunity to note the period during which the incubation lasted.

The length of time which may elapse before trachoma declares itself is often considerable, even though the person concerned may have been continually in contact with contagion. The reviewer remembers that Ray reported the case of a physician in America who married a young lady who had trachoma. He lived with her for 15 years before he caught the disease, although his wife had had many exacerbations of the condition with copious discharge during that time.

Such a case, illustrating the occasional slowness of the healthy eye to become infected, enables one to understand the not infrequent occurrence of monocular trachoma, which may exist for years.

A. F. MACCALLAN.

(2) **Pacalin, G.—A new method of deep cauterisation of the conjunctiva in the treatment of trachoma.** (**Un nouveau mode de cautérisation profonde appliqué au traitement de la conjonctivite granuleuse.**) *Ann. d'Ocul.*, Vol. CLXII, p. 425, 1925.

(2) **Pacalin** states that in the vast majority of cases of trachoma, in the infiltrated stage after the stage of acute trachoma with its granulations or papillae has passed, the disease affects with its waxy infiltration not only mucous tissue or conjunctiva, but also sub-mucous tissue. This infiltration is, in the vast majority of cases, confined to the region of the upper border of the tarsus and to the upper fornix immediately superior to this.

The treatment he recommends is as follows: (1) Anaesthetization, superficial and deep, after careful cleansing of the field of operation. Details of this are given in full. Points of importance in the anaesthetization by subconjunctival injection are that as much as 2 c.c. of solution are necessary, and that the solution be carried freely to the inner and outer extremities of the tarsal border.

(2) Scarification in this area in a direction parallel with the upper border of the tarsus and brushing with 2 per cent. sublimate solution, according to the method of Abadie and Darier. Numerous incisions are made, especially near the upper tarsal border. Persistence is required in the use of the sterilized brush, but also gentleness.

(3) Several applications, at separate points, of thermocautery or galvano-cautery are made close against the upper border of the everted tarsus into the tissue, water-logged by anaesthetic solution, and to a depth of about 0.5 cm.

(4) The after-treatment is as follows: daily for five days, cocainization, irrigation of conjunctival sac with a 20 c.c. syringe and a Morax cannula filled with 1/1,000 cyanide solution. Instillation of a few drops of argyrol (20 per cent.). The application of moist compresses. In about twenty days cicatrization is complete.

(5) About the sixth day, the application of solid copper sulphate is made, and once weekly afterwards. On the intervening evenings, the instillation, after eversion of the lid, of copper sulphate drops (2 per cent. copper sulphate, 5 per cent. cocain hydrochloride, dissolved in equal parts of glycerine and distilled water). Every morning a few drops of 20 per cent. argyrol are instilled, which is believed by the author to check secondary infection.

HUMPHREY NEAME.

(3) **Terson, A.—Some procedures of technique in the treatment of trachoma. (Quelques éléments techniques de la cure de trachome.)** *Ann. d'Ocul.*, Vol. CLXII, p. 414, 1925.

(3) **Terson** divides his paper into two parts. The first deals with active trachoma with infiltration; the second, with refractory and complicated cases. His methods of treatment include: (1) the use of silver nitrate solutions, in strength from 1 to 2 per cent.; (2) when the activity of the disease and the discharge are lessened, the application of glycerole of copper (2 per cent., 5 per cent. or 10 per cent.), with 2 per cent. of novocain and synthetic guiacol; (3) as a change of treatment, salicylarsinate of mercury (enesol) in 3 per cent. solution, as obtainable in ampoules, is applied. This solution is unstable if kept in air. As an alternative (4) 1/1,000 sublimate solution; (5) or bluestone, which should not be applied on a freshly-scarified surface; (6) scarification and multiple puncture with a tattoo needle. This may be followed by the application of a mercurial salt; (7) only in exceptional cases, is the actual cautery applied to the tarsal conjunctiva, but deep and separated points of cauterization of the upper fornix are sometimes very efficacious.

The pain which follows the use of copper sulphate is controlled by the use of 1 per cent. oily solution of acoin. The cornea may be isolated from the copper-impregnated conjunctiva by a layer of special taffeta-chiffon ("Gommchiffon") covered on each side with a layer of sterilized vaseline. This can be left in place for a few moments after the everted lid has been allowed to return to its place.

To aid the examination and treatment of the superior fornix, an instrument called a "propulseur" of the *cul-de-sac* is employed. (Terson, *Ann. d'Ocul.*, 1923). This may be employed without the use of an anaesthetic.

(8) Conjunctival injections of cyanide (presumably oxycyanide of mercury), a few drops of 1/3,000 to 1/1,000, or of enesol, 1/1,000 to 1/500 are used. These require the use of subcutaneous and subconjunctival injection of 4 per cent. novocain with adrenalin.

In intractable cases with corneal ulceration the application, at separated points, of the actual cautery to the depth of the upper fornix gives in some cases a favourable result. In a somewhat similar manner and for the same reason, excision of a strip of lozenge-shaped portion of the *cul-de-sac* is sometimes successful. Excision of the tarsal plate is discountenanced.

For cases of moderate pannus, periectomy with removal of a circular band of conjunctiva around the cornea except for two bridges of conjunctiva which are always allowed to remain, has a beneficial effect. In cases of extreme pannus, nothing is so successful as the use of jequirity. This drastic method of treatment is only employed when the trachoma is of the dry type and the pannus is almost of a fatty appearance.

HUMPHREY NEAME.

(4) **Terson.—Trachoma League, Scientific Session. (Ligue du trachome, séance scientifique.)** March 28, 1925.

(4) **Terson** (son) gives a warm appreciation of his empirical methods in the treatment of trachoma. He describes an instrument for exposing to view the conjunctiva of the upper fornix. Those of us who are unable to get a satisfactory view by pressing lightly on the globe through the lower lid after everting the upper lid, can usually get an excellent view by using a strabismus hook applied from the skin surface of the everted lid. He says that he has never seen the utility of excisions of the tarsus in the treatment of trachoma. This is not the opinion of Barrada of Egypt, who is quoted in Spaeth's recent book on "Plastic Ophthalmic Surgery" (Blakiston, Philadelphia), as reporting a series of 325 excisions of the tarsus with the overlying conjunctiva, many of them in cases of trachoma in which there was neither trichiasis nor entropion.

ABADIE must have horrified his audience when he stated that in particularly serious cases of trachoma he is in the habit of inoculating the conjunctiva with the secretion from a case of purulent conjunctivitis; to cure this, when purulent conjunctivitis declares itself, he uses two or three times a day applications of

3 or 4 per cent. solution of silver nitrate. This method of treatment is not then a legend culled from ancient text-books as the reviewer had supposed.

MORAX and also SÉDAN spoke favourably of the subconjunctival injection behind the retrotarsal fold of a solution of copper sulphate in strengths of 0.25 to 1 per cent., containing adrenalin and novocain. The reaction, however, in spite of the analgesic action of the novocain may be very severe. There is usually a great deal of oedema and the pain is great. This method was first used by Nicati in 1924.

SÉDAN related a remarkable case of infection with trachoma of four small boys in the family of a rich stockbroker, who lives at Marseilles. The first boy affected had been under constant observation by Sédan on account of his myopia, and his conjunctivae were perfectly normal until the engagement of an English nurse. This nurse was born at Margate, and had been in the service of the family of an English official at Cairo; at the end of three years' service she had complained of her eyes, "like all the children in the family." She was found to be trachomatous by Sédan. It is an extraordinary rarity for the child of a British official to become infected with trachoma, owing to the care which is taken to prevent all contact between native servants and the younger members of the family. A. F. MACCALLAN.

(5) **Anti-trachoma measures in France. Prophylactic instructions drawn up by the Superior Council of Public Hygiene of France. (Instructions prophylactiques élaborées par le Conseil Supérieur d'Hygiène Publique de France.)** *Revue du Trachome*, April, 1925.

(5) Trachoma is a notifiable disease in France, and the Superior Council of Public Health have issued prophylactic instructions as to the disease which are here reproduced in English:

"Trachoma is a chronic contagious disease characterized by a lesion visible to the naked eye, the trachoma granule, situated on the conjunctiva (especially on the palpebral conjunctiva and principally on the tarsus); it is of slow development, and is often complicated at all its stages with serious alterations in the eyesight.

This disease may attack man at any age. The children of trachomatous parents are almost always infected in their earliest years. It is due to a specific virus, which passes through a porcelain filter, and which causes hypertrophy of the lymphatic follicles of the conjunctiva; it provokes the formation of little swellings, at first soft, bursting by pressing between the nails, or against a curette, and which, when they are old, become fibrous, and provoke in their contraction a change in direction of the eyelashes.

Contagion is effected by the tears, by direct contact with the fingers, or for example by kissing, and often by means of flies which can transport the virus from a distance. It is provoked or facilitated by irritating dust, by sand which is inclined to make one rub one's eyes with the hand, or with soiled linen. The incubation period is barely more than a few days. The disease lasts for months, often even for years without ceasing to be transmissible at all its stages.

Trachoma is particularly met with in Northern Africa, in the Levant and in Indo-China. It is to-day very widely spread in all the tropical and subtropical countries where flies abound, and no race is exempt. Commercial relations, navigation, railroads, and the interpenetration of the peoples, especially since the world war, have facilitated its diffusion in Europe. One sees it now almost everywhere in France and it constitutes a danger against which it is important to be armed.

Prevention of Trachoma

The only means actually known to avoid the propagation of the disease consist :

(1) In seeking and treating as early as possible trachoma cases.

(2) In instructing people who live in contact with these cases as to what measures they should take to keep themselves and their children from contagion.

When a trachomatous person is discovered the case will be notified to the Health Office, which in conjunction with the medical man treating the case, will follow it up to complete cure by an ophthalmologist, and will arrange, if possible, for sending the patient for treatment in a special hospital, or in certain cases for the return of the patient to his own country.

The surroundings of the patient will be examined, and everyone who has been exposed to contagion will be provided with the necessaries for washing, with droppers and solutions of glycerinated sulphate of copper, 1 in 40, and taught how to use them, as well as with any prophylactic instructions which may be necessary.

Protection against Flies

Very special attention will be paid to protection against flies, to driving them away, and to their destruction. In hospitals and at home trachomatous persons will be preserved from contact with them by mosquito nets for the bed, and by wire netting, of two millimetres gauge, fixed on doors and windows.

Disinfection

Instruments, linen, and dressings, which have been soiled with trachomatous virus will be immersed as soon as possible in a

solution of sodium cresol, 4 per cent., or sterilized by boiling in carbonate of soda solution, 2 per cent. The patient will be advised never to rub his eyes except with thin linen, and to plunge his hands after washing with soap in a solution of copper sulphate, 2 per cent."

These excellent instructions are signed officially by Calmette and Roux, and, we believe, have been adopted on the recommendation of "La Ligue contre le Trachome," of which Morax is the moving spirit.

A. F. MACCALLAN.

(6) **Sédan, J. (Marseilles).—*Seven cases of trachoma in children infected by their nurses.* (Sept las de contagion trachomateuse infantile, du fait de "nurses.")** *Ann. d'Ocul.*, Vol. *CLXII, p.* 437.

(6) **Sédan** reports the occurrence of trachoma, four cases in one family, three in another, in which there appears to be clear evidence that the infection was spread from the children's nurse in each case. The disease occurred in well-to-do families, private patients whose children had been under repeated observation and examination for several years. There had in none of them been any sign of conjunctival inflammation previously. In each case, a recent type of trachoma developed in the children, while signs of considerable duration of the disease were present in the two nurses. In the case of the former family all the children of the class which they attended at school were examined and found free from signs of trachoma. The children of the second family were educated at home.

HUMPHREY NEAME.

III.—ANATOMY AND PHYSIOLOGY

(1) **Johnson, G. Lindsay (Durban).—A new theory of accommodation. (Une nouvelle théorie de l'accommodation.)** *Arch. d'Ophtal.*, December, 1924.

(1) After a brief summary of the theory of Helmholtz, with which he is not in accordance, **Johnson** explains his views thus:

The two ciliary muscles (radial and circular) contract and draw forward the choroid, at the same time compressing the ciliary processes which are pushed into the circumlental space by the action of the muscle of Müller. This exerts pressure on the fluid which fills this space. Fluids being incompressible, some

structure must yield. This can only be the capsule, which is pressed inwards compressing the circumference of the lens. The posterior surface of the lens resting on the vitreous cannot change, the anterior alone becomes more convex. In doing so it exerts pressure on the fluid in the circumlental space and anterior chamber, and in its expansion drives some of this fluid into the spaces of Fontana. As soon as accommodation is relaxed the fluid flows back into the anterior chamber. Thus, in the author's view, the increase in curvature of the anterior surface of the lens is produced by hydraulic pressure, and not as explained by Helmholtz.

J. B. LAWFORD.

(2) **Noiszewski, Kazimierz, Prof.—*The hydraulic mechanism of accommodation.*** (**Le mécanisme hydraulique de l'accommodation.**) *Arch. d'Ophtal.*, August, 1925.

(2) A recent communication to the "Archives d'Ophtalmologie" by Lindsay Johnson,* induced Professor Noiszewski to reiterate his views on the mechanism of accommodation which he had communicated to the Congress of Oculists of Poland, in 1921.†

Noiszewski's theory is as follows: During accommodation the circular ciliary muscle compresses the fluid in the posterior chamber; this fluid imprisoned in this chamber by the contraction of the sphincter pupillae compresses in its turn the equator of the lens. The aqueous humour flows from the anterior chamber at the filtration angle, but the fluid from the posterior chamber cannot reach this outlet owing to the obstruction due to the contracted sphincter of the iris. Consequently the pressure in the anterior chamber is lowered and the higher pressure in the posterior chamber compresses the crystalline lens. The only part on which the increased pressure in the posterior chamber cannot exert an effect is the anterior pole of the lens, unprotected by iris. Owing to the lowered pressure in the anterior chamber this expands and becomes more convex.

In support of his views the author quotes the observations of Foerster and others who noted that a keratocele of Descemet's membrane disappeared during the act of accommodation (when the anterior chamber pressure became lowered) and re-appeared during the period of relaxation.

J. B. LAWFORD.

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*Lindsay Johnson.—*Une nouvelle théorie* de l'accommodation. *Arch. d'Ophtal.*, December, 1924.

†Noiszewski.—*Gazeta Lekarska*, No. 15, Klinika Oczna, 1923.

(3) **Viguri, Adolfo V. (Mexico).—Ocular tension and general arterial tension. (Tensión ocular y tensión arterial general.)** *Anal. de la Soc. Mexicana de Oftal. y Oto-Rino-Laringol.*, Tomo IV, No. 5, p. 114, 1923.

(3) **Viguri** has conducted an exhaustive statistical investigation into the relation between ocular tension and the systemic arterial tension, making measurements upon 290 individuals of varying ages, using a MacLean tonometer, and adrenalin-cocain as anaesthetic. He finds that the normal tension of the eye varies from 20 to 30 mm. Hg., and that the variations above and below these limits are few and unimportant. In persons of less than 15 years the tension is usually somewhat higher than in adults, fluctuating between 25 and 30 mm. Hg.

The arterial tension, on the other hand, as measured by the oscillometer of Pachon, was found in adults to vary from 100 to 130 mm. Hg., and in persons under 15 to be considerably less—between 60 and 100 mm.

The general lack of correspondence between the two sets of figures, the small age variation in the ocular tension and the marked difference in arterial tension, with their inverse relative change, lead the author to infer "the lack of direct influence of the general arterial tension on the ocular tension."

W. S. DUKE-ELDER.

(4) **Wegner, W.—The action of massage and experimental engorgement in the normal and glaucomatous eye, (Massagewirkung und Stauungversuche am normalen und glaucomatösen Auge.)** *Zeitschr. f. Augenheilk.*, Bd. LV, H 6, ss. 381-393, 1925.

(4) In a series of more than a hundred patients **Wegner** has tested the effect of repeated tonometric applications on the ocular tension, using the Schiötz instrument with the 5.5 grm. weight. With the patient in the horizontal position, and taking tonometric readings using one short application of the tonometer at one minute intervals for ten minutes, he finds a drop in tension averaging 3.2 mm. Hg., or of about 16.5 per cent. The fall is greatest after the first few applications; it becomes negligible after the fifth or sixth. He does not accept these results as beyond the limits of experimental variation under the conditions necessarily obtaining clinically.

By means of a small amount of massage the tension of the normal eye can be lowered distinctly and rapidly, a decrease of from one-third to one-half of the original value being readily obtained. The effect of massage in lowering the ocular tension is less marked in the glaucomatous eye than in the normal eye; while

in the former a lowering of 10 mm. Hg. is obtained, as for example, from 50 to 40 mm. This cannot be compared on a percentage basis to a lowering of from 20 to 10 mm. Hg. (*i.e.*, of 50 per cent.).

The ocular tension is influenced by the attitude of the body—a vascular effect. In the normal eye a change of position of the body through an angle of 30° involves a variation of tension of about 3.5 to 4 mm. Hg., with the head raised producing a decrease, with the head lowered an increase of tension. In the glaucomatous eye this reaction is much more marked than in the normal eye; in the former the author obtains with a similar declination a variation of from 8 to 10 mm. Hg.

Comparative references given are:

Schiötz.—*Arch. f. Augenheilk.*, Vol. LII, 1905.
Stock.—*Klin. Monatsbl. f. Augenheilk.*, Beilageheft, 1910.
R. Polak and v. Gelder.—*Klin. Monatsbl. f. Augenheilk.*, 1911.
Cestelli.—*Arch. di Ottal.*, Vol. XX, p. 181.
P. Knapp.—*Klin. Monatsbl. f. Augenheilk.*, Vol. I, p. 1, 1912.
Wessley.—*Heidelberger Kongress*, 1912.
Lohlein.—*Heidelberger Kongress*, 1912.

W. S. DUKE-ELDER.

(5) **Libby, George F. (Denver, Colorado.)—Medullated nerve fibres involving the macula.** *Amer. Jl. of Ophthal.*, September, 1925.

(5) **Libby's** case occurred in the left eye of a boy aged 6½ years, the right eye being normal. The refraction of the left eye was -18D., and medullated nerve fibres were seen to overlap the entire periphery of the optic disc, extending for 1.25 to 4.5 disc diameters from it and covering the macula. A striking V-shaped area of clear retina showed below the macula. There was loss of central vision and fixation, and the only part of the field showing vision was an area 150° vertically by 20° horizontally, in the lower temporal quadrant. The clear area of retina below the macula showed no response whatever in taking the field. A second case is reported by Edward Jackson occurring in one eye only, which again was myopic (12D.), and had medullated nerve fibres passing over the macula. An interesting feature is that the course of these fibres was directly over this area, *i.e.*, there was no anatomical macula or fovea. In attempting to fix with this eye, the patient used a part of the retina to the nasal side of the disc and slightly below the level of its centre.

F. A. WILLIAMSON-NOBLE.

BOOK NOTICES

Das Augenzittern als Gehirnstrahlung. Ein Atlas der Augenzitternkurven. (Nystagmus a Cerebral Radiation. An Atlas of Nystagmus Curves.) By Prof. Dr. JOHANNES OHM. Berlin: Urban & Schwarzenberg. 1925. Pp. 326. Price 21 marks.

The social importance of miners' nystagmus has raised that particular form of disturbance of ocular movements into a prominence which tends to interfere with its proper scientific consideration. Writers on the subject, naturally enough being mostly concerned in arriving at some practical standpoint as to how to deal with this particular form of the disease nystagmus, lose their sense of proportion and forget that nystagmus is a very large subject and miners' nystagmus only a minor part of it. The writer of the present book on nystagmus, though he has had much experience of miners' nystagmus and though the majority of his curves are from such cases, yet manages to view the subject as a whole. For the last twenty years he has thought and written on this one subject alone, and the present book merits the serious consideration of everyone interested in the subject of disturbances of ocular movements. Even if they may not agree with the main thesis of the book, they will find gathered up a mass of facts on the subject and many interesting and suggestive conjectures. His main object is to show that nerve stimuli have a periodicity like light, electricity, heat and sound, and can be best treated on an undulatory basis. An analysis of the curves obtained in cases of nystagmus shows that they can be arranged in a harmonic scale. Harmonic analysis reveals the true relationship of the simple waves of pendulum nystagmus to the stepped waves of jerky nystagmus with its slow and rapid phases. The stepped waves and saddle waves simply result from the superposition of overtones in the harmonic scale on what may be called the fundamental tone. Ohm regards the physiological condition of normal eyes as one in which the amplitude of vibration is very small and the frequency very high (over 2,000 per minute). In nystagmus, the amplitude of vibration is increased and its frequency diminished until it reaches a point at which the vibrations can be seen. His curves show that in some cases of nystagmus light tends to damp down the amplitude and quicken the rate of vibration until the physiological state is reached and no movement is perceptible. In miners' nystagmus he considers vestibular factors and proprioceptive impulses from the head and neck muscles play a part in the causation almost as important as the retinal factor.

Ohm is evidently both poet and musician and if, at times, his imaginative poetic faculty carries him into flights far above the common hard ground of fact, it adds to the interest of reading, and, as we have already said, the dull and prosaic amongst us who may not care to trust ourselves into the higher levels can still find the facts of the subject in this book.

Die Augenkrankungen des Kindesalters in ihrer besonderheit. By Dr. L. HEINE. **Beihefte zum Jahrbuch für Kinderheilkunde.** Edited by A. CZERNY. Berlin: S. Karger. 1925. Pp. 52, illustrations 9. Price 3 marks.

This monograph represents an attempt to describe the clinical features and the treatment of those diseases of the eye to which children are especially prone, within the limits of 52 pages. It also includes brief references to pathology and pathogenesis.

The author has succeeded in compressing a vast amount of information into the pages allotted to him, but in so condensed a form that we have grave doubts of its utility. We find it difficult to believe that these very brief articles, written, and as in this instance well written, as part of a Year Book or Systematic Treatise, possess any real value as contributions to knowledge or as sources of instruction to students.

Heine's article is in 26 sections. It opens with a tabular statement of the development of the eye, at monthly intervals from the middle of the first month of foetal life. Following this is a short section on congenital anomalies, after which the author deals with diseases of the various structures of the eye and its surroundings, including sections on diseases of the orbit, disorders of the optic tracts and centres, errors of refraction, and concluding with a section on wounds and one on ocular disturbances of special interest to school medical officers and teachers, such as blinking, headaches, etc. The book is well printed on glazed paper and the few illustrations have been judiciously chosen and well reproduced.

Swanzy's Handbook of Diseases of the Eye and their Treatment. By LOUIS WERNER. Thirteenth edition. London: H. K. Lewis & Co., Ltd. Pp. 698, with 278 text illustrations and nine coloured plates. Price 21s.

The last edition of this well-known text-book appeared in 1919 and was duly noticed in our columns (*Brit. Jl. of Ophthal.*, Vol. IV, p. 91). The present edition is but little altered. In spite of the addition of 25 pages and five illustrations the publishers have been able to make a slight reduction in the price. The chapter on diseases of the uveal tract has been altered by the removal of diseases of the choroid to the chapter on diseases of the retina.

Sympathetic ophthalmitis is still dealt with under the heading of diseases of the iris and ciliary body. The index as well as the text has been revised, but we still fail to find any reference in it to the important work of Gordon Holmes and Lister on the cortical representation of the retina (adequately treated in the text) although such comparatively trivial subjects as Kenneth Scott's operation for ectropion are referred to under their authors' names. We trust the author will not increase the size of the book in the next edition if he intends to retain the original title of a "Handbook." The book can safely be recommended as a reliable manual for students and practitioners, and is quite amongst the best of its class.

Ophthalmic Nursing. By MARY MASON SPRINGGAY. London: Methuen & Co., Ltd. 1925. Pp. 10 + 133, with illustrations. Demy 8vo. Price 5s.

This little book is especially designed to help those nurses who are working in ophthalmic hospitals, and the author has succeeded in presenting her subject in a simple and concise manner. She gives effective and painstaking advice, the anatomical descriptions of the eye are clear, and all that are needed for the probationer, and the illustrations are good.

The book will certainly be helpful although one feels that enough attention is not devoted to the actual nursing of eye cases. It is necessary to recognize that the ultimate success of many eye operations must be considerably influenced by the care of the nurse, and in order that she may be really helpful she must understand how depressing is the condition of blind helplessness, especially in such cases as those of detached retina (which by the way, is not mentioned), ulcerated cornea, and after operations for cataract and glaucoma, and how much she can do to help towards the success of an operation by making convalescence less tedious.

It should be noted that the methods of treatment after operation are apparently those adopted at the Western Ophthalmic Hospital, and, however good they may be, they are not such as are uniformly adopted in eye hospitals.

NOTES

Honorary LL.D.

WE congratulate Mr. Priestley Smith on the Honorary Degree of Doctor of Laws which has been conferred on him by the University of Birmingham.

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Obituaries

THE death is announced of ALFRED TERSON, at the age of 87 years, in October of last year. He was in practice at Toulouse from 1865-1921. In 1891, he was appointed to the charge of the newly-formed Ophthalmological Clinic of the Faculty of Medicine of Toulouse, a post he held for five years. He leaves two sons, Albert Terson of Paris, and Jean Terson of Toulouse, both ophthalmologists.

The death is also announced of HERMANN KUHNT, at the age of 76 years, in October of last year. Kuhnt succeeded Saemisch as Professor of Ophthalmology at Bonn, and made numerous contributions to ophthalmic literature, the majority of which deal with improvements in operative technique.

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Oxford Ophthalmological Congress, 1926

Mr. P. H. ADAMS has been elected Master of the Oxford Ophthalmological Congress for 1926. Dr. Thomson Henderson has accepted the invitation of the Council to deliver the Doyne Memorial Lecture. The subject chosen for discussion at the 1926 Meeting is "Sympathetic Ophthalmia."

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Royal London Ophthalmic Hospital Dinner

THE Annual Dinner of Past and Present Students of the Royal London Ophthalmic Hospital will be held at the Langham Hotel, Portland Place, on Thursday, February 11, 1926, at 7 for 7.30 o'clock. Chairman, Sir Thomas Barlow, Bart., K.C.V.O. Tickets (excluding wine) 15s., may be obtained from Sir William Lister (24, Devonshire Place, W.1) or Mr. Charles Goulden (79, Portland Place, W.1) secretaries.

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Ophthalmological Society of the United Kingdom

THE Annual Meeting of the Society will take place at the Royal Society of Medicine, London, on Thursday, Friday, and Saturday, April 29, 30, and May 1, 1926. The subjects for discussion are:—"Birth Injuries of the Eye" and "Intra- and Extra-ocular Melanomata." The Annual Dinner will be held at the Langham

Hotel on Thursday, April 29. A visit to the National Physical Laboratory at Teddington has been arranged for Saturday afternoon, May 1. Those who wish to take part in discussions or to present papers should communicate with Mr. H. P. Gibb, 53, Harley Street, W.1.

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International Committee

AT the general meeting of the Convention of English-Speaking Ophthalmological Societies held in July a resolution was passed empowering its president, Mr. E. Treacher Collins, to appoint a Committee of five; to obtain, if possible, the co-operation of delegates from the various national ophthalmological societies, in the promotion of an International Ophthalmological Congress, and other matters of international ophthalmological interest.

The following have agreed to serve on this committee: Dr. Edward Jackson, Denver, U.S.A.; Dr. George de Schweinitz, Philadelphia, U.S.A.; Sir John Parsons, C.B.E., F.R.S.; Mr. Leslie Paton; Mr. E. Treacher Collins, Chairman.

FUTURE ARRANGEMENTS

1926

January 8.—Royal Society of Medicine, Section of Ophthalmology.

February 5.—North of England Ophthalmological Society at Liverpool.

February 12.— Royal Society of Medicine, Section of Ophthalmology.

March 5.—North of England Ophthalmological Society at Sheffield.

March 12.—Royal Society of Medicine, Section of Ophthalmology (Clinical).

April 9.—North of England Ophthalmological Society at Newcastle.

April 29—*May* 1.—Ophthalmological Society of the United Kingdom (Annual Meeting).

May 10.—Société française d'Ophtalmologie, Annual Congress.

May 14.—Royal Society of Medicine, Section of Ophthalmology.

June 11.—Royal Society of Medicine, Section of Ophthalmology (Annual).

July 14—17.—Oxford Ophthalmological Congress.